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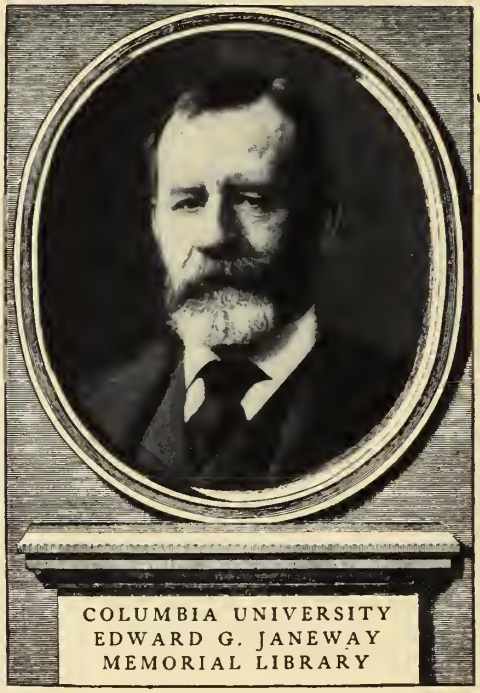

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TRANSACTIONS

OF THE

AMERICAN CLIMATOLOGICAL ASSOCIATION

FOR THE YEAR 1918

VOLUME XXXIV

"The object of this Association shall be the study of Climatology and Hydrology and of Diseases of the Respiratory Organs."—*Constitution.*

PRINTED FOR THE ASSOCIATION
1918

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NOTICE.

The Association assumes no responsibility for the statements and opinions expressed in the papers read at its meetings.

PRESS OF
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

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PRESIDENTS.

Capt. J. H. Elliott, A.M.C., Toronto, Canada, 1918.
Guy Hinsdale, M.D., Hot Springs, Va., 1919.

VICE-PRESIDENTS.

W. G. Schauffler, M.D., Lakewood, N. J., 1918.
H. M. Bracken, M.D., St. Paul, Minn., 1918.
Jos. H. Pratt, M.D., Boston, Mass., 1919.
H. M. Kinghorn, M.D., Saranac Lake, N. Y.

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Arthur K. Stone, M.D., Framingham Center, Mass.

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Thomas Darlington, M.D., New York.
Lawrason Brown, Saranac Lake, N. Y., Alternate.

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LIST OF OFFICERS.

Presidents.

Name	Year
A. L. Loomis	1884–5
William Pepper	1886
Frank Donaldson	1887
A. L. Loomis	1888
V. Y. Bowditch	1889
Charles Denison	1890
F. I. Knight	1891
W. E. Ford	1892
R. G. Curtin	1893
A. H. Smith	1894
S. E. Solly	1895
J. B. Walker	1896
E. Fletcher Ingals	1897
E. O. Otis	1898
Beverley Robinson	1899
Abraham Jacobi	1900
Robert H. Babcock	1901
Samuel A. Fisk	1902
Norman Bridge	1903
James C. Wilson	1904
W. F. R. Phillips	1905
E. L. Shurly	1906
Thomas Darlington	1907
Thomas D. Coleman	1908
Charles E. Quimby	1909
Edward R. Baldwin	1910
John Winters Brannan	1911
Alexander D. Blackader	1912

Name	Year
Charles L. Minor	1913
James M. Anders	1914
Henry Sewall	1915
James Alexander Miller	1916
Judson Daland	1917
Jabez H. Elliott	1918
Guy Hinsdale	1919

Vice-Presidents.

F. I. Knight, W. H. Geddings	1884–5
Frank Donaldson, Beverley Robinson	1886
V. Y. Bowditch, R. G. Curtin	1887
A. Y. P. Garnett, J. T. Whittaker	1888
J. R. Leaming, E. T. Bruen	1889
A. L. Gihon, H. B. Baker	1890
E. L. Trudeau, T. S. Hopkins	1891
E. Fletcher Ingals Beverley Robinson	1892
A. H. Smith, E. O. Otis	1893
I. Hull Platt, E. L. Trudeau	1894
John H. Musser, G. R. Butler	1895
Charles E. Quimby, James A. Hart	1896
S. A. Fisk, John C. Munro	1897
Beverley Robinson, C. F. McGahan	1898
James A. Hart, R. C. Newton	1899
R. H. Babcock, J. W. Brannan	1900
Albert C. Peale, S. W. Langmaid	1901
Norman Bridge, W. F. R. Phillips	1902
James C. Wilson, H. S. Orme	1903
Thomas Darlington, Thomas D. Coleman	1904
S. G. Bonney, S. D. Risley	1905
A. D. Blackader, Henry Sewall	1906
Frank Fremont-Smith, C. L. Minor	1907
Judson Daland, Charles Fox Gardiner	1908
E. R. Baldwin, C. E. Edson	1909

Name	Year
James M. Anders, H. Longstreet Taylor	1910
Will Howard Swan, John H. Lowman	1911
Herbert Maxon King, Carroll E. Edson	1912
James M. Anders, C. D. Alton	1913
Lawrason Brown, Will Howard Swan	1914
Arthur K. Stone, James Alex. Miller	1915
Philip King Brown, Henry M. Bracken	1916
W. L. Dunn, J. E. Elliott	1917
W. G. Schauffler, H. M. Bracken	1918
Joseph H. Pratt, Hugh M. Kinghorn	1919

Secretaries and Treasures.

James B. Walker	1884–5
Guy Hinsdale	1895
Arthur K. Stone	1918

LIST OF MEMBERS.

Honorary Members.

Elected

1888. Abbot, Griffith E., 722, Main Street, Worcester, Mass.
1914. Fox, R. Fortescue, Devonshire Place, W., London.
1914. Garnett, A. S., Hot Springs, Arkansas.
1916. Gorgas, William C., Surgeon-General, U. S. A. War Department, Washington, D. C.
1914. Gros, Edmund L., 23, Ave. du Bois de Boulogne, Paris, France.
1917. Marvin, Prof. Charles F., Chief of the Weather Bureau, Washington, D. C.
1902. McBride, James H., Pasadena, Cal.
1914. Philip, Sir Robert W., Charlotte Square, Edinburgh, Scotland.
O.M.* Reed, Boardman, Alhambra, Cal.
O.M. Robinson, Beverley, 42 West 37th Street, New York.
1911. Stupart, Sir Robert F., K.B., F.R.S.C., Director, Dominion Meteorological Service, Toronto, Canada.
1898. Sunderland, Septimus, 11, Cavendish Place, Cavendish Square, W., London.
O.M. Tyndale, J. Hilgard, Richards Block, Lincoln, Nebraska.
1917. Ward, Prof. R. De Courcey, Harvard University, Cambridge, Mass.
1897. Weber, Sir Hermann, 10, Grosvenor Street, W., London, England.
1907. Williams, Leonard L. B., 123, Harley Street, W., London.
1917. Wright, Sir Almroth, St. Mary's Hospital, London, England.

* O.M., Original Member.

Corresponding Members.

Elected

1912. Carpenter, Ford A., Central Building, 6th and Main Streets, Los Angeles, Cal.

1898. Eyre, G. G., Claremont, Cape Town, South Africa.

1911. Grenfell, Wilfred, C.M.G., St. Anthony, Newfoundland.

1912. Henderson, Professor Yandell, 440, Prospect Street, New Haven, Conn.

1908. Liston, Major W. Glen, C.I.E., Indian Medical Service, Director of the Bacteriological Laboratory, Bombay, India.

1910. Rogers, Lieut.-Colonel Sir Leonard, C.I.E., F.R.C.S., Indian Medical Service, Professor of Pathology, Medi cal College, Calcutta, India.

1904. Sandwith, Fleming Mant, C. M. G., 32, Cavendish Square, W., London.

1902. Weber, F. Parkes, 13, Harley Street, W., London.

1914. Wood, Neville, 42, Elvaston Place, Queen's Gate, London.

Emeritus Members.

1897. Alton, Charles D., 1310, Asylum Avenue, Hartford, Conn.

1885. Ford, William E., Utica, New York.

Active Members.

1914. Alsever, William D., 727, East Willow Street, Syracuse, New York.

1899. Anders, James M., 1605, Walnut Street, Philadelphia.

1890. Anderson, B. P., 1231, N. Cascade Avenue, Colorado Springs, Col.

1900. Arnold, Horace D., 520, Commonwealth Avenue, Boston.

1893. Babcock, R. H., 74, East Elm Street, Chicago.

1917. Baetjer, Walter A., 11, E. Chase Street, Baltimore.

1915. Bailey, Walter C., 506, Beacon Street, Boston.

Elected

1898. Baldwin, Edward R., Saranac Lake, N. Y.

1901. Barlow, W. Jarvis, Security Building, Los Angeles, Cal.

1907. Barnes, Harry Lee, Wallum Lake, R. I.

1902. Bergtold, William H., 910, Metropolitan Building, Denver, Col.

1897. Blackader, Alexander D., 236, Mountain Street, Montreal, Canada.

1914. Blue, Rupert, Surgeon-General, U. S. Public Health Service, Washington, D. C.

1897. Bonney, S. G., Stedman Building, Denver, Col.

1895. Boardman, W. S., 63, Mt. Vernon Street, Boston.

1885. Bowditch, V. Y., 506, Beacon Street, Boston.

1901. Bracken, Henry Martyn, 1010, Fourth Street, S. E., Minneapolis, Minn.

1891. Brannan, John W., 48, West 51st Street, New York City.

1894. Bridge, Norman, Temple Auditorium, Los Angeles, Cal.

1903. Brown, Lawrason, 104, Main Street, Saranac Lake, N. Y.

1903. Brown, Philip King, 516, Sutter Street, San Francisco, Cal.

1897. Brown, Sanger, Kenilworth, Illinois.

1907. Browning, Charles C., Merritt Building 8 and Broadway, Los Angeles, Cal.

1909. Bushnell, George E., U. S. A., c/o Surgeon-General, War Dept., Washington, D. C.

1886. Butler, G. R., 226, Gates Avenue, Brooklyn.

1914. Byers, John Roddick, Ste. Agathe des Monts, P.Q., Canada.

1896. Campbell, W. A., 424, N. Nevada Ave., Colorado Springs, Col.

1910. Carrington, P. M., U.S. P.H. Service, San Diego, Cal.

Elected

1906. Claytor, Thomas A., 1826, R. Street, N. W., Washington, D. C.
1901. Cobb, J. O., U.S. P.H. Service, Marine Hospital, Chicago
1894. Coleman, Thomas D., 505, Greene St., Augusta, Ga.
1901. Collins, Charles Farnham, 50, West 55th Street, New York City.
1889. Coolidge, A., 613, Beacon Street, Boston.
1917. Craig, Frank A., 244, South 21st Street, Philadelphia.
1910. Crane, Bayard T., Rutland, Mass.
1907. Da Costa, John C., jun., 264, South 15th Street, Philadelphia.
1892. Daland, Judson, 317, South 18th Street, Philadelphia.
1890. Darlington, Thomas, 27, Washington Square North, New York City.
1907. Darnall, Wm. Edgar, 1704, Pacific Ave., Atlantic City.
1897. Davis, N. S., 7, West Madison Street, Chicago.
1910. Dixon, Samuel G., Harrisburg, Penn.
1905. Dunn, William LeRoy, Asheville, N. C.

1897. Edson, Carroll E., McPhee Building, Denver, Col.
1915. Elliott, John Barnwell, jun., 608, Maison Blanche, New Orleans, La.
1903. Elliott, J. H., II, Spadina Road, Toronto, Canada.

1912. Farrand, President Livingston, Boulder, Colorado.
1910. Floyd, Cleaveland, 246, Marlborough Street, Boston, Mass.
1917. Forster, Alexius M., Colorado Springs, Colo.
1911. Fulton, Frank Taylor, 36, Prospect Street, Providence, R. I.

1896. Gardiner, C. Fox, 818, North Cascade Avenue, Colorado Springs, Col.
1892. Gibson, William M., 260, Genesee Street, Utica, N. Y.
1915. Goodman, Edward H., 248, South 21st Street, Philadelphia.

Elected

1099. Griffin, Walter Alden, Sharon, Mass.

1907. Hall, J. N., 452, Metropolitan Building, Denver, Col.
1912. Hamman, Louis, 714, Park Avenue, Baltimore.
1893. Hance, I. H., Lakewood, N. J.
1891. Hart, James A., P. O. Box 144, Geneva, N. Y.
1912. Hastings, Thomas W., 172, East 71st Street, New York.
1912. Hatfield, Charles J., 2008, Walnut Street, Philadelphia.
1914. Hawes, John B., 2nd, 29, Gloucester Street, Boston, Mass.
1896. Heffron, John L., 608, East Genessee Street, Syracuse, N. Y.
1912. Hewlett, A. Walter, Leland Stanford University Medical School, Sacramento, and Webster St., San Francisco, Cal.
1893. Hinsdale, Guy, Hot Springs, Virginia.
1902. Hoagland, Henry W., 818, North Nevada Avenue, Colorado Springs, Col.
1914. Holden, G. Walter, Agnes Memorial Sanatorium, Denver, Colorado.
o.m. Ingals, E. Fletcher, Monroe Buildings, 104, So. Michigan Boulevard, Chicago.

1889. Jacobi, A., 19, East 47th Street, New York.
1888. Jayne, W. A., 408, Metropolitan Building, Denver, Col.
1901. Jennings, Charles Godwin, 457, Jefferson Street, Detroit, Michigan.
1915. Johnston, Collins H., 87, Monroe Ave., Grand Rapids, Michigan.

1907. Kinghorn, Hugh M., 14, Church Street, Saranac Lake, N. Y.
1899. Klebs, Arnold C., c/o—M. Forbes and Co., Sears Bldg., Boston.
1917. Klotz, Walter C., Barlow Sanatorium, Los Angeles, Calif.

Elected

1910. Landis, H. R. M., II, South 21st Street, Philadelphia.
1914. Lee, Roger I., Harvard University, Cambridge, Mass.
1914. Lichty, John A., 4634, Fifth Avenue, Pittsburg, Pa.
1917. Lloyd, John, Iola Sanatorium, Rochester, N. Y.
1909. Locke, Edwin Allen, 311, Beacon Street, Boston, Mass.
1913. Lord, Frederick T., 305, Beacon Street, Boston.
1904. Lowman, John H., 1807, Prospect Ave., S. E., Cleveland, O.
1907. Lyman, David Russell, Wallingford, Conn.

1906. Manges, Morris, 72, East 79th Street, New York.
1902. Marvel, Philip, 1616, Pacific Avenue, Atlantic City, N. J.
1917. Matson, Ralph C., 1021, Corbett Building, Portland, Oregon.
1917. Matson, Ray W., Corbett Bldg., Portland, Oregon.
1917. Meader, Charles N., 304, McPhee Bldg., Denver.
1915. Mercur, Wm. H., 5244, Fifth Ave., Pittsburg, Pa.
1905. Miller, James Alexander, 379, Park Ave., New York.
1909. Miner, Charles H., 115, South Franklin Street, Wilkesbarre, Pa.
1899. Minor, Charles L., Asheville, N. C.
1917. Montgomery, Charles M., 2210, Locust Street, Philadelphia, Pa.
1909. Morgan, James Dudley, 919, Fifteenth Street, N. W., Washington, D. C.

1895. Newton, R. C., 42, Church Street, Montclair, N. J.
1907. Nichols, Estes, 188, State Street, Portland, Maine.
1907. Nichols, John B., 1321, Rhode Island Ave., N. W., Washington, D. C.
1917. Niles, Walter L., 56, East 77th Street, New York.
1912. Norris, George W., 1530, Locust Street, Philadelphia.

1888. Otis, E. O., 381, Beacon Street, Boston.

Elected

1913. Parfitt, C. D., Gravenhurst, Ontario, Canada.
1912. Paterson, Robert Childs, Saranac Lake, New York.
1906. Perkins, Jay, 125, Waterman Street, Providence, R. I.
1895. Phillips, W. F. R., School of Medicine, Charleston, S. C.
1917. Piersol, George Morris, 1913, Spruce Street, Philadelphia.
1887. Platt, Walter B., 802, Cathedral Street, Baltimore.
1917. Porter, George D., 162, Crescent Road, Toronto, Canada.
1902. Pottenger, F. M., 1100, Title Insurance Building, Los Angeles, Cal.
1905. Pratt, Joseph H., 317, Marlborough Street, Boston.
1917. Price, J. Woods, Saranac Lake, N. Y.
1914. Probst, Charles O., 185, State Street, Columbus, Ohio.
1905. Pryor, John H., 26, Linwood Ave., Buffalo, N. Y.

1891. Quimby, Charles E., 278, West 86th St., New York.

1885. Rice, C. C., 123, East 19th Street, New York.
1901. Richardson, Charles W., 1317, Connecticut Avenue, Washington, D. C.
1904. Richer, A. J., Ste. Agathe des Monts, Province of Quebec, Canada.
1917. Ringer, Paul H., Asheville, N. C.
1890. Robinson, W. D., 2012, Mt. Vernon St., Philadelphia.
1902. Rochester, Delancey, 469, Franklin Street, Buffalo.
1890. Rogers, E. J. A., 222, Colfax Avenue, Denver, Col.
1917. Russell, Nelson G., 469, Franklin Street, Buffalo, N. Y.

1905. Schauffler, William Gray, 400, Madison Ave., Lakewood, N. J.
1901. Sewall, Henry, 1360, Vine Street, Denver, Col.
1915. Shattuck, George Cheever, 205, Beacon Street, Boston.
1910. Shurly, B. R., 32, Adams Avenue W., Detroit, Mich.
1887. Smith, Frank Fremont, Bar Harbor, Maine.

Elected

1917. Smith, Wm. H., 10, Gloucester Street, Boston.
1911. Steiner, Walter R., 4, Trinity Street, Hartford, Conn.
1909. Stevens, Martin L., Asheville, N. C.
1904. Stone, Arthur K., 44, Fairfield St., Boston, Mass.
1915. Stone, Willard J., 326 Chamber of Commerce Building, Pasadena, Cal.
1910. Swan, John M., 457, Park Avenue, Rochester, N. Y.
1901. Swan, Will Howard, 1440, North Nevada Avenue, Colorado Springs, Col.

1892. Taylor, H. Longstreet, 810, Lowry Building, St. Paul, Minn.
1907. Taylor, J. Gurney, 330, Wells Building, Milwaukee, Wisconsin.
1896. Taylor, J. Madison, 1504, Pine Street, Philadelphia.
1910. Thomas, John D., 1726, M. Street, N. W., Washington, D. C.

1917. Waters, Bertram H., 40, East 41st Street, New York.
1917. Webb, Gerald B., Colorado Springs, Colo.
1911. White, William Charles, Bedford Ave. and Wandless St., Pittsburg, Pa.
1898. Whitney, H. B., 320, Temple Court, Denver, Col.
1898. Williams, Harold, 528, Beacon Street, Boston.
1885. Williams, H. F., 416, Grand Avenue, Brooklyn.
1911. Williams, Linsly R., Albany, New York.
1910. Wilson, Gordon, 4, East Preston St., Baltimore.
O.M. Wilson, James C., 1509, Walnut Street, Philadelphia.
1917. Wilson, Robert, jun., Charleston, S. C.
1913. Wood, Nathaniel K., 520, Beacon Street, Boston.

MINUTES.

The 35th annual session was called at the Boston Medical Library on June 5, 1918, the president, Capt. Jabez H. Elliott, A.M.C., in the chair.

The opening paper was by Prof. Robert deCourcy Ward, of Harvard University on "The Larger Controls of the Climates of the United States."

Fifteen papers were read in the three sessions by the following: Drs. Floyd, Phillips, Hance, Porter, Parfitt, Newton, Paterson, Kinghorn, Robinson, Elliott, Johnston, Otis, Heffron, Perkins and Pratt.

At the business session on the first day the following were noted as present: Lt. Col. H. D. Arnold, M.R.C., Dr. R. H. Babcock, Dr. Walter Bailey, Dr. E. R. Baldwin, Dr. W. S. Boardman, Dr. V. Y. Bowditch, Dr. J. W. Brannan, Dr. L. Brown, Col. Geo. E. Bushnell, U.S.A., Dr. Jr. Byers, Dr. A. Coolidge, Dr. B. T. Crane, Dr. W. L. Dunn, Dr. C. E. Edson, Capt. J. H. Elliott, C.A.M.C., Dr. Cleaveland Floyd, Lt. Col. A. M. Forster, U.S.A., Dr. F. T. Fulton, Dr. W. A. Griffin, Dr. I. H. Hance, Dr. J. B. Hawes, Dr. J. L. Heffron, Dr. Guy Hinsdale, Major H. W. Hoagland, U.S.A., Dr. G. W. Holden, Dr. C. H. Johnston, Dr. H. M. Kinghorn, Dr. Walter C. Klotz, Dr. H. R. M. Landis, Dr. John Lloyd, Dr. E. A. Locke, Dr. F. T. Lord, Dr. W. H. Mercur, Dr. J. A. Miller, Dr. R. C. Newton, Major Estes Nichols, U.S.A., Dr. E. O. Otis, Dr. C. D. Parfitt, Dr. R. C. Paterson, Dr. Jay Perkins, Dr. W. F. R. Phillips, Capt. George D. Porter, A.M.C., Major J. H. Pratt, Capt. J. Woods Price, M.R.C., U.S.A., Dr. W. D. Robinson, Dr. W. R. Steiner, Dr. A. K. Stone, Prof. R. deC. Ward, Dr. W. Charles White, Dr. N. K. Wood. Guests: Dr. Frank C. Neal, Peterboro, Canada; Capt. Bruce Hopkins, A.M.C.; Dr. C. H. Vrooman, Kamloops, Canada.

The Secretary reported the following changes in the mem-

bership: Dr. Boardman Reed, one of the original members of this Association, and more recently an honorary member, died October 31, 1917, at his home in Alhambra, California, at the age of seventy-five. Mr. N. Hay Forbes, a corresponding member since 1910, died at his home in Church Stretton, England, on June 27, 1916. Dr. Fleming Mant Sandwith, a corresponding member since 1904, died at Bournemouth, England, February 17, 1918. Dr. Herbert Maxon King, an active member since 1904, died at his home in Liberty, N. Y. on June 24, 1917. A memorial of him by Dr. Lawrason Brown appeared in the last copy of our TRANSACTIONS. Dr. Thomas J. Mays, an active member for thirty years, died at his home in Philadelphia, February 14, 1918. Dr. Samuel G. Dixon an active member since 1910, died on February 26, 1918. Dr. E. Fletcher Ingals, an original member, died in Chicago, April 10, 1918. Dr. P. M. Carrington and Dr. A. W. Hewlett have resigned. Dr. E. J. A. Rogers, Dr. C. E. Quimby, Dr. C. D. Alton and Dr. Fremont Smith have been made emeritus members. Dr. Rupert Blue, the Surgeon General of the Public Health Service, has been made an honorary member.

The president appointed Dr. W. L. Dunn and Dr. Jay Perkins auditors of the treasurer's books. Dr. C. L. Minor, Dr. Bowditch and Dr. Otis were appointed on the nominating committee.

The following resolution was introduced by Dr. Phillips to the effect that the Association recommend to President Wilson the reappointment of Major General W. C. Gorgas as Surgeon-General of the Army. Seconded by Dr. R. C. Newton. Carried unanimously.

WHEREAS, Major General William C. Gorgas, Surgeon General of the Army, will reach in November of this year the age of compulsory retirement under existing law unless he be continued in duty by the President of the United States; and whereas the record of achievement of General Gorgas in Cuba, in Panama, and in the present World War has earned him the admiration

and confidence of the medical profession as an executive, a scientist, and a man; and we believe that no other member of the medical profession possesses so unreservedly this admiration and confidence.

Therefore, be it resolved, That the American Climatological and Clinical Association trusts that the President will deem it right and proper to continue General Gorgas in his present office until the successful and victorious close of the present war for liberty, humanity and righteousness.

Be it further resolved, That a copy of these resolutions be forwarded the President.

(These were forwarded and acknowleged by the President, saying he had referred them to the Secretary of War.)

Dr. R. H. Babcock brought up the subject of the income tax and protested against the levying of an excess profit tax on physicians. After discussion by Dr. Lawrason Brown, Dr. J. A. Miller, Dr. Phillips and Dr. Dunn, Dr. Kinghorn and Dr. Babcock a motion relating to this matter was lost.

Dr. Heffron moved a vote of thanks to the Committee on Arrangements and also to the Chairman on Library and Finance of the Medical Library for the use of the hall.

The Secretary read the list of names recommended for active membership.

Adjourned.

Minutes of the Business Meeting on June 6, 1918.

The Nominating Committee made a report as following: For president, Dr. Guy Hinsdale; for vice-presidents, Major Joseph H. Pratt and Dr. Hugh M. Kinghorn; for secretary and treasurer, Dr. A. K. Stone; for recorder, Dr. W. Duffield Robinson, for member of the Council, Dr. J. H. Elliott; for delegate to the executive committee of the Congress of American Physicians and Surgeons, Dr. Thomas Darlington, Dr. Lawrason Brown alternate.

It was moved and seconded that the president cast a ballot for those named. There being no objection, those named were declared unanimously elected.

Dr. Hinsdale thanked the Association for the high honor conferred upon him and for the cordial coöperation with him in his service of twenty-three years as secretary and treasurer.

A vote of thanks was extended to the Boston members for their hospitality and for the luncheon and automobile drive.

The ballots for membership having been counted the tellers reported the following elected: Major John D. McLean, M.R.C., Surgeon-General's Office, Washington, D. C., Major Lawrence Litchfield, M.R.C., Pittsburgh; Dr. Fred H. Heise, Saranac Lake, N. Y.; Dr. Charles W. Crankshaw, Newark, N. J.; Dr. A. G. Shortle, Albuquerque, N.M.; Dr. John P. Sawyer, Cleveland, Ohio; Major Raymond Clark, M.R.C., Brooklyn, N. Y.

The Association then adjourned to luncheon as guests of the Boston members.

At the annual dinner at the Tavern Club forty-three members were present.

Guy Hinsdale,
Secretary.

MEMORIAL

FLEMING MANT SANDWITH, C.M.G., M.D., F.R.C.P.*

It is our sad duty to record the death of an eminent Corresponding fellow in the person of Dr. Fleming Mant Sandwith, who was elected to fellowship in our Association in 1904.

Dr. Sandwith died suddenly on February 17, 1918, at Bournemouth, where he had gone for the benefit of his health after serving for two years as consulting physician in Egypt to the Eastern Mediterranean Force with the temporary rank of colonel.

Fleming Mant Sandwith was born in 1853, the second son of Colonel J. W. F. Sandwith. He was educated at Charter House and St. Thomas's Hospital and took the diploma of M.R.C.S. 1876 and that of L.R.C.P.Lond. in the following year. In 1893 he was graduated M.D. Durham and became F.R.C.P. in 1900. He saw a great deal of service in various wars. He was an ambulance surgeon in the Turco-Serbian war of 1876 and in the Russo-Turkish campaign in 1877–8; he was present at the fighting at Shipka Pass and served on Baker Pasha's staff during his retreat across the Rhodope Mountains. In 1883 he went to Egypt to combat a cholera epidemic, and acted as vice-director of the Public Health Department of the Egyptian government until 1885. He was then appointed professor of medicine in the Egyptian Government School, and physician to the Kasr-el Ainy Hospital, Cairo. In 1900 he became senior physician to the Imperial Yeomanry Hospital at Pretoria, and served throughout the South African war. He was the author of "Medical Diseases of Egypt" and "Egypt as a Winter Resort," and when he settled in London, maintained his keen interest in tropical diseases. He was lecturer on tropical diseases at St. Thomas's

* For the following sketch we are indebted to the *British Medical Journal.*

Hospital, and was a lecturer, also, in the London School of Tropical Medicine, as well as senior physician to the Albert Dock Hospital. He held the chair of Gresham Professor of Physic in the City of London. He was a member of many medical societies at home and abroad; he was president of the Section of Tropical Medicine at the annual meeting of the British Medical Association in London in 1910, having been vice-president at Leicester in 1905. He delivered the Lettsomian Lectures at the Medical Society of London on dysentery in 1914, and wrote many papers on the prevention and treatment of tropical diseases. In the earlier part of the war he was physician to King George's Hospital. In 1916 he received the C.M.G. in recognition of his services in Egypt. He married the daughter of Dr. Humphrey Sandwith, of Kars, who survives him, with two sons,—one a lieutenant in the navy, the other still a school boy,—and two daughters, the elder of whom is married to Squadron Commander Maude, R.N.A.S.

The above is a brief account of Dr. Sandwith's medical career, but he would add a few words about "the man" rather than the "doctor." For those who really knew him there was a charm about his personality which greatly endeared him to his friends. Very quiet, almost reserved of manner, with a half cynical pose which was more assumed than real and which was relieved by a most delightful sense of humor, he was one of the kindest of men, always ready to help, saying little or nothing about it. He had a wonderful power of sympathy, and of looking at things from the point of view of those who sought his advice—a power which greatly added to his usefulness in the world.

His health latterly had not been good, and some time ago he underwent a severe operation from which, however, he made a good recovery. But he felt the strain of the last two years in Egypt, and the heat, which was more than usually intense, greatly taxed his strength. When he returned home, about two months ago, his friends could not fail to recognize that he was worn and jaded. He was still anxious to work, and his retire-

ment from the army was a great disappointment to him; but he took it quietly with a smile, and in the true spirit of a soldier. He died gently in his sleep—a happy ending to a strenuous life.

BOARDMAN REED, M.D.

Dr. Reed was one of the original members of this Association. A graduate of the Medical School of the University of Pennsylvania in 1878, he settled in Atlantic City and took a prominent part in developing that resort. When he first went there the future popularity and importance of Atlantic City as a resort were unknown, but Dr. Reed soon made the advantages of its climate known to the medical profession. After several years of general practice he removed to Philadelphia, where he devoted himself to diseases of the stomach as a specialty and enjoyed a large consulting practice. During these years he wrote a work on "Diseases of the Stomach" and contributed a great many articles on that subject to periodicals.

Fifteen years ago Dr. Reed removed to Alhambra, California, near Los Angeles, and continued in practice until he suffered a paralytic stroke in 1913. He died on October 31, 1917, aged seventy five.

Dr. Reed was a veteran of the Civil War and a member of the Loyal Legion. He endeared himself to all associated with him, was an enthusiastic, hard worker and a skilful diagnostician and practitioner. He leaves a widow, Mrs. Gertrude Phelps Reed, a daughter, Mrs. H. J. Hogle, and a son, H. Phelps Reed.

SAMUEL G. DIXON, M.D., LL.D., D.SC.*

Few states have been better served by a public servant, who at the same time was a distinguished citizen, than has Pennsylvania by Dr. Samuel G. Dixon, the Commissioner of Health

* From the *Public Ledger*.

since the establishment of the new department in 1905. By family and training representative of the best in Philadelphia, possessing professional abilities of marked order, not only in his chosen line of medicine, but also in the law, since he was also a member of the bar, and forced by the obligation of large means to take a practical part in financial and corporation as well as institutional affairs, Dr. Dixon never lost his enthusiasm for public service. This was his calling, this was the thing nearest to his heart; and whatever his other activities, they seemed to spur him on to new endeavors in his work for the state. His ambition was to make the Department of Health the thing closest to the people and at their command for their protection individually and in all social and communal relationships. Naturally, the intensity of the application in developing what is recognized as a model department in twelve years, on an enormous scale at that, led to the serious impairment of his own health. His death, therefore, is a real sacrifice to the good of the commonwealth, and no heroic action on the field of battle could be more marked by evidence of devoted patriotism than is the fact that for years after he was ordered to give up work he kept unremittingly at it and stuck it out to the very end.

While his work as the administrator of a great department, which was virtually his own creation, will be his chief monument, it is to be remembered that Dr. Dixon was something more than a scientific executive, however well he may have deserved the recognition for this kind of service that came to him from his community and the country at large. In fact, as a bacteriologist, as a specialist in hygiene, sanitation and preventive medicine, he was an original investigator in laboratories abroad and at home. His work on variations of the tubercle bacillus and his development of tuberculins, some of which antedated the Koch discoveries of 1889, gave him priority in a field which is still exercising the attention of specialists, with many of the original claims of the German savant marked as not accepted. Moreover, Dr. Dixon, through his long tenure of office as president of

the Academy of Natural Sciences, which under him celebrated its centenary, was one of a group of men who held America true to its traditions as a country where, whatever the material distractions were, the cause of pure science should never be allowed to languish. Dr. Dixon's work in these lines was applied immediately in the department work, and the scientific character of the organization as a whole is unexcelled anywhere in the country. In the treatment of the large endemic diseases, such as typhoid and tuberculosis, while a past master in the matter of prevention and believing that above all question of the cure of disease was the need of protecting the public from it, at the same time he overlooked none of the means or methods of cure that his department might apply broadly the state over. Hence the intelligent use of antitoxins, the thorough application of vaccines and the development of the sanatoria for the tuberculous were all part and parcel of the same careful concern for the public that gave the department its gold medal for preeminence at the Panama-Pacific Exposition.

As a result of his twelve years of arduous labor, Pennsylvania has a Department of Health that is recognized as reaching the highest American standard. What this means to the people is shown in the decrease of the death rate and in the fact that the incidence of certain diseases once common is decreasing almost to invisibility. Moreover, the orderly administration that underlies comfort of the individual and the uplift of the community were all developed by Dr. Dixon, who utilized the old and shaped the new legislation to promote those ends that he believed would make Pennsylvania the model sanitary commonwealth of the Union. That he had largely accomplished this was the only satisfaction he asked for. And that his unselfish services to his state afforded an example to officials and public servants unfortunately all too rare is not the least thing to his credit.

Dr. Dixon became a member of this Association in 1910, but his very arduous duties prevented his taking an active part in our meetings. According to Governor Stuart, he spent more

hours in his office than any other officer in the Capitol, and it was oftener after than before midnight when his work was ended.

He was president of the Medical Society of Pennsylvania when he died and was serving his twenty second term as president of the Pennsylvania Academy of the Natural Sciences, for which he gave the energy of his best years. He died at the University of Pennsylvania Hospital of anemia, February 26, 1918, aged sixty six.

THOMAS J. MAYS, M.D.

Dr. Mays, who had been a member of this Association for thirty years, died at his home in Philadelphia on February 14, 1918, at the age of seventy-two. He died of apoplexy after a two weeks' illness. He was widely known as a medical writer and specialist in diseases of the lungs and heart. He was born near Schaefferstown, Pa., held a degree of A.M. from Ursinus College and M.D. from Jefferson Medical College, from which he was graduated in 1868.

In 1885 he moved to Philadelphia, and associated himself with the Polyclinic Hospital. In 1888 he was elected professor of diseases of the chest. He was one of the organizers of the Rush Hospital for Consumptives in 1890, and was one of its visiting physicians for years. He was also one of the visiting physicians to St. Mark's Home for Aged Women, and a consulting physician at the Institution for Feeble-Minded Children in Vineland, N. J.

Dr. Mays was a member of the American Medical Association, the American Neurological Association, Pennsylvania State Medical Society, and the College of Physicians of Philadelphia.

His activities covered a wide field and he was an original investigator, independent and firm in his convictions. These he maintained with force. He maintained an attitude on the origin of consumption differing in important respects from the prevailing view in that he attributed to it a strong etiologic influence from

the nervous system. He published a work entitled "Pulmonary Consumption a Nervous Disease." He was warm hearted and friendly with all his associates, notwithstanding he often differed radically from them on medical questions. In recent years he experimented with rattlesnake venom.

E. FLETCHER INGALS, M.D.

Ephraim Fletcher Ingals, former president of this Association, died April 30, 1891, at his home in Chicago. He will be remembered as a genial comrade, bright alert, interested in all that was being done about him. He was modest and unassuming, but had definite opinions upon which he acted promptly and steadily. His judgment was excellent. He was a thorough student of his specialty and a careful and capable practitioner of it. Naturally he won success in his profession and eminent success in his specialty.

E. Fletcher Ingals, the son of Charles Francis and Sara L. (Hawkins) Ingals, was born at Lee Center, Ill., September 29, 1848. He was educated at Rock Seminary, Mount Morris, Ill. In 1871 he received the degree of doctor of Medicine from Rush College. That year he became interne at Cook County Hospital. In 1879 the (old) Chicago University conferred upon him the degree of master of arts. He studied and traveled in Europe in 1873.

He began his career as a teacher and his lifelong association with medical schools immediately after graduation in medicine in 1871, by becoming assistant professor of materia medica in his alma mater. This position he held for two years. In 1874 he became lecturer on diseases of the chest and on physical diagnosis. From 1883 to 1890 he was professor of laryngology. From 1890 to 1893 the title of his department was laryngology and practice of medicine, which was later changed to laryngology and diseases of the chest. From 1898 to his death he was pro-

fessor of diseases of the chest, nose and throat. In this year he was also made comptroller of his alma mater. The interests of this institution were always closest to his heart. He was active in the improvement of its courses and methods of teaching: Also most active in bringing about the affiliation of Rush Medical College with the University of Chicago.

From 1879 to 1898 he held the chair entitled diseases of the throat and chest in Northwestern University Medical School for Women, and from 1890 to his death, the professorship of rhinology and laryngology in the Chicago Polyclinic. In 1901 he was made lecturer on medicine in the University of Chicago.

His students regarded him as an inspiring teacher, full of learning and ability. His general interest in medical education made him an active member of the American Medical College Association of which he was one time president.

He was a member of the Chicago Medical Society, the Chicago Pathological Society, the Chicago Institute of Medicine, the Chicago Laryngological and Climatological Society, the Illinois State Medical Society, American Laryngological Association, American Climatological and Clinical Association, and fellow of the American Medical Association. Of many of these societies he served as president or in them held important offices. He was trustee of the American Medical Association from 1893 to 1896 and from 1900 to 1903. In 1883 he was chairman of the section of laryngology in the Pan-American Medical Congress. Since 1880 he has been a member of an attended many of the International Medical Congresses which have been held.

Dr. Ingals has contributed a long list of articles to the periodical press of his profession and to the volumes of transactions of societies to which he belonged. His well-known book on "Diseases of the Nose, Throat and Chest" has passed through the fourth edition.

He was a public-spirited citizen, interested in the improvement of Chicago and in the institutions which furthered it. Some years before his death he was made first lieutenant in the

Medical Reserve Corps of the United States Army, he held the rank of captain at the time of his death.

Of social clubs in Chicago he was a member of the University Club, the Quadrangle Club, and the Flossmoor Country Club.

For several years, Dr. Ingals has suffered attacks of angina pectoris which finally caused his death. In spite of this, most cheerfully and heroically he worked when he could and did his part. His last contribution to his profession was an address on angina pectoris at a recent meeting of the Chicago Institute of Medicine and published just before his death in the *Journal of the American Medical Association*. In it he describes his own experiences as well as those observed in others.

Dr. Ingals leaves a wife, Lucy S. Ingals, whom he married September 5, 1876, and four children: Francis E., Melissa R. (Mrs. C. L. Fisher), Mary Goodell and E. Fletcher Ingals, Jr.

In Dr. Ingals we have lost a faithful, cheerful, inspiring friend whom we have learned to esteem and whose memory we will cherish.

N. S. D.

CONSTITUTION AND BYE-LAWS.*

CONSTITUTION.

Article I.—Name.

This Society shall be known as the American Climatological and Clinical Association.

Article II.—Object.

The object of this Association shall be the Clinical Study of *Disease, especially of the Respiratory and Circulatory Organs, and of Climatology and Hydrology.*

Article III.—Membership.

Section 1.—This Association shall consist of *active, corresponding, Emeritus,* and *honorary* members, the former not to exceed 150 and the latter not to exceed twenty (20).

Section 2.—Names of candidates for active membership, whose applications shall have been endorsed by *three* (3) active members, shall be sent to the Secretary at or before the annual meeting at the second business session of which they shall be read and then lie over until the next annual meeting, when such as are approved by the Council shall be balloted on. Three (3) black balls shall be sufficient to reject a candidate. The Council shall have power to nominate active members.

Candidates for membership shall, at the discretion of the Council, present a paper to the Association showing clinical study of merit.

Section 3.—The power of nominating honorary and corresponding members shall be vested in the Council. The election shall be conducted in the same manner as that for active mem-

* As amended May 10, 1916.

bers. Honorary members shall enjoy all the privileges, but shall not be allowed to hold any office or cast any vote.

Section 4.—Anyone who has been an active member of this Association for twenty (20) years in good standing, and has attained the age of sixty (60) years, may become an Emeritus member by expressing his desire to do so, in writing to the Council, and he shall thereafter be exempt from all dues and duties of the Association.

Section 5.—Any member of the Association absent from the meetings, in person or by contributed paper, for three (3) consecutive years, without sufficient cause, shall be dropped from the list of members by vote of the Council.

Article IV.—Officers.

Section 1.—The officers of this Association shall consist of a *President*, two *Vice-Presidents*, a *Secretary and Treasurer*, and a *Recorder*, who, with the Delegate to the Executive Committee of the Congress of American Physicians and Surgeons or his alternate and five other members, shall constitute the *Council* of the Association.

Section 2.—*Nominations.* The officers, including the Council, shall be nominated by a committee of five (5) members, which committee shall be nominated by the President at the first session of each annual meeting and shall report at the business meeting.

Section 3.—*Elections.* The election of officers shall take place at the business meeting. A majority of votes cast shall constitute an election.

Section 4.—The President, Vice-Presidents, Secretary and Treasurer, and Recorder shall enter upon their duties at the close of the annual meeting at which they are elected, and shall hold office until the close of the next annual meeting, or until their successors are elected.

Section 5.—Members of the Council, other than the President, Vice-Presidents, Secretary and Treasurer, shall hold office for five (5) years.

Section 6.—*Vacancies.* Any vacancy occurring among the officers of the Association during the year may be filled by the Council.

Article V.—Duties of Officers.

President and Vice-Presidents.

Section 1.—The President and Vice-Presidents shall discharge the duties usually devolving upon such officers. The President shall be *ex-officio* Chairman of the Council.

Secretary and Treasurer.

Section 2.—As Secretary, he shall attend and keep a record of all the meetings of the Association and of the Council, of which latter he shall be *ex-officio* Clerk. At each annual meeting he shall announce the names of all who have ceased to be members since the last report. He shall notify candidates of their election to membership. He shall send a preliminary notification of the annual meeting two (2) months previous thereto, and the programme for the annual meeting at least two (2) weeks previous to its assembly, to all the members of the Association. He shall also send notification of the meetings of the Council to the members thereof. At each annual meeting of the Association he shall read the minutes of the previous meeting and of all the meetings of the Council that have been held during the current year.

Section 3.—As Treasurer, he shall receive all moneys due, and pay all debts therewith. He shall render an account thereof at the annual meeting, at which time an auditing committee shall be appointed to report.

Recorder.

Section 4.—The Recorder shall secure the papers read and also proper notes of the discussions thereon and shall superintend, under the direction of the Council, the publication of the Transactions.

Article VI.—Council.

The Council shall meet as often as the interests of the Association may require.

Four (4) members shall constitute a quorum.

It shall have the management of the affairs of the Association, subject to the action of the Association at its annual meetings.

It shall consider the claims of candidates recommended to it for admission to membership.

It shall not have the power to make the Association liable for any debts exceeding in total one hundred dollars ($100), in the course of any one year, unless specially authorized by a vote of the Association.

It shall have the entire control of the publications of the Association, with the power to reject such papers or discussions as it may deem best.

It shall have power to nominate active members at the annual meeting.

The Council shall have power to invite any gentleman, not a member, to read a paper at the annual meeting, on any subject within the scope of the objects of this Association.

The Council shall determine questions by vote, or—if demanded—by ballot, the President having a casting vote.

The Council shall constitute a Board of Trial for all offences against the Constitution and Bye-laws, or for unbecoming conduct, and shall have the sole power of moving the expulsion of any member.

The President, or any two members, may call a meeting, notice of which will be transmitted to every member two (2) weeks previous to the meeting.

Article VII.—Papers.

Section 1.—The titles of all papers to be read at any annual meeting shall be forwarded to the Secretary not later than one (1) month before the first day of the meeting, in order to appear on the printed programme.

Section 2.—No paper shall be read before the Association which has already been printed or been read before another body.

Article VIII.—Quorum.

A quorum for business purposes shall be ten (10) members.

Article IX.—Amendments.

This Constitution may be amended by a four-fifths (4/5) vote of all the members present at an annual meeting, provided that notice of the proposed amendment has been printed in the notification of the meeting at which the vote is to be taken.

BYE-LAWS.

(1) Meetings of the Association shall be held annually.

(2) The time and place of the meetings shall be determined by the Council.

(3) The dues of active members shall consist of an annual assessment not to exceed seven and a half ($7.50) dollars. Members in arrears shall not be entitled to vote. Those in arrears for two (2) years may be dropped from membership by recommendation of the Council.

(4) Order of business meeting.

First day:—

Calling the roll of members.
Minutes of previous meeting.
Secretary's and Treasurer's reports.
Recorder's report.
Report of Committee of Arrangements.
Appointment of auditing committee.
Appointment of nominating committee.
Report of Council on recommendations for membership.

Second day, Morning session:—

Reports of nominating committee and auditing committee.
Election of officers.
Election of members.
Nomination of candidates for membership.
Report of committee on health resorts.
Unfinished business.
Miscellaneous business.
Adjournment of business meeting.

MEETING OF THE AMERICAN CLIMATOLOGICAL AND CLINICAL ASSOCIATION AT BOSTON, JUNE 5, 1918.

The president, Capt. J. H. Elliott, made an introductory address and stated that he would read his paper tomorrow, when he would show lantern slides of x-ray plates.

Prof. R. DeCourcy Ward, of Harvard University, read a paper (from manuscript) on "The Major Controls of the Climates of the United States."

THE MAJOR CONTROLS OF THE CLIMATES OF THE UNITED STATES.

By ROBERT DeC. WARD,

Professor of Climatology, Harvard University.

Climate in General.—Climate is *average weather.* Weather types change from day to day, and from season to season, under varying controls. Climate, also, is the resultant of many variables. One climate differs from another because of a different combination of these controls. It is a relatively simple matter to enumerate the factors which combine to produce any given climate, but it is difficult, if not impossible, to determine the relative importance of these different controls, so intimately are they connected and so complex are their effects.

The Major Controls of Climate.—The sun is obviously the fundamental control of climate. This control is commonly known as (1) *Latitude.* If the sun alone were concerned, all places on the same latitude circle would have the same climate.*

Such a condition is, however, very decidedly modified by (2)

* *Solar climate* is the term for a climate which is controlled solely by the amount of solar radiation which any place receives by reason of its latitude.

the distribution and influence of *land and water*, (3) *mountain barriers*, (4) *altitude*, (5) *prevailing winds*, (6) *ocean currents* and (7) *storms*. The reaction of the physical features and conditions of the earth's surface upon the atmosphere results in what is termed *physical climate*. According to the dominant control in each case we may have *continental*, *marine*, or *mountain* climates. In the first, land is the essential control; in the second, the ocean; in the third, altitude. An extreme development of the continental type is a *desert* climate. A transitional type, between continental and marine, is a *littoral* climate.* The relative importance of the various controls of climate, and the types of climate which result from their interaction, vary greatly in different places, according to the geographical location, and the physical, topographic, atmospheric and other conditions peculiar to each district. For the United States, the outstanding facts regarding each of these major controls are here briefly stated.

Latitude.—The difference in latitude between the northern and the southern portions of the United States determines the important fact that the mean annual, the seasonal, and the monthly isotherms as a whole show prevailingly lower temperatures in the north than in the south.† Yet these isotherms do not run east and west across the continent, as they would were latitude the sole control. Their deflections from the latitude lines show the influence of other factors, which often to a marked degree, and sometimes even completely, overcome the effect of latitude.

Land and Water.—Land and water are fundamentally different in their behavior regarding absorption and radiation. Land areas, and the air over them, warm and cool readily and

* For fuller details regarding the characteristics of these different types of climate, see R. DeC. Ward, "Climate Considered Especially in Relation to Man," 8vo, 2d ed., New York, and London, G. P. Putnam's Sons, 1918.

† See, *e.g.*, the charts of monthly and annual isotherms in Bartholomew's "Atlas of Meteorology," 1899, Pls. 7 and 8; also the mean annual, January and July isothermal charts in the series of "Climatic Charts of the United States," U. S. Weather Bureau.

to a considerable degree. Water areas, and the air over them, warm and cool slowly, and relatively little. The larger continental areas of the middle and higher latitudes therefore have great seasonal fluctuations in temperature. They are distinctly radical in their tendencies. The oceans, on the other hand, are conservative. They warm but little during the day, and in summer. They cool but little during the night, and in winter. Another essential difference between oceans and continents is that the waters of the oceans are almost constantly in motion while the lands are stationary. The temperatures of the oceans in higher and in lower latitudes thus tend to become equalized. The land masses, on the other hand, have to take the temperature appropriate to their latitude and season. It follows, therefore, that North America as a whole is cooler in winter and warmer in summer than the adjacent oceans in similar latitudes. This is clearly shown on the isothermal charts for January and July.* In the average for the year, the southern portions of North America are warmer, while the northern portions are colder, than the adjacent oceans in similar latitudes.

It has been of great importance in the history of the United States that the continent broadens to the north. The races which have migrated from Europe to make up the American people have thus been able to spread over a vast extent of country in the temperate zone, having climatic conditions not very unlike those of their old world homes. Were the continent broadest to the south, in the trade wind zone, an American Sahara would replace the Gulf of Mexico, and the great agricultural regions of the United States would be correspondingly less extensive. The usefulness of North America as a new home for the overflowing populations of Europe would under such conditions have been very greatly restricted.

In the United States, the controlling water areas are: (*a*) the Pacific and (*b*) the Atlantic Oceans, (*c*) the Gulf of Mexico, and, to a much less degree, (*d*) the Great Lakes. Neither of

* See footnote, p. 22.

the two oceans can attain its maximum control over the climate of the adjacent continent; the Pacific, in spite of its being on the windward side of the continent, because of the presence of the massive mountain barrier near the coast; the Atlantic, because it is to leeward. On the narrow Pacific slope, the climates are unlike those elsewhere in the country, and in many respects resemble those of western and southern Europe. Being exposed to the influence of the Pacific, with the prevailing winds blowing directly from the conservative ocean, the climates are on the whole relatively mild and equable, with slight seasonal fluctuations. The seasonal contrasts are most marked where the marine influence is lessened, as in the valleys to the east of the Coast Range. The Slope thus has various types of transitional littoral climates, with increasingly marked continental features over the sections which are most effectively shut off from the ocean influences.

The influence of the Atlantic Ocean is much diminished by the fact that the "prevailing" winds are offshore. The Atlantic coastal belt, except when the winds temporarily blow onshore, does not differ very much from the interior. Fairly large mean annual ranges of temperature, characteristic of a continent, are carried eastward to the coast, and even over the ocean, for some distance offshore.* Thus the summers are warm and the winters are cold. The Southern States naturally have milder winters than do the States farther north, owing to the lower latitudes and the greater frequency of warm winds in the south. The importance of the Atlantic Ocean as a source of water supply is very considerable. To the water vapor brought from the Atlantic by easterly storm winds the abundant and well-distributed rainfall of the eastern States is largely due. The increase in the mean annual rainfall from the interior toward the Atlantic Ocean, and the general parallelism of the rainfall lines with the Atlantic coast, indicate that much water vapor is supplied from that ocean.

* See "Atlas of Meteorology," Pl. 2, Text, p. 8.

The Gulf of Mexico is an important control of the climates east of the Rocky Mts. It occupies latitudes which in the Old World include the desert of Sahara. It is a very warm body of water.* Its maximum effects are seen during the summer, for then the prevailing winds over most of the eastern United States are from southerly (southeast, south, southwest) directions. These winds are well laden with vapor, and are important in supplying the summer rainfall. Furthermore, throughout the year, and especially in winter, temporary warm and damp winds, associated with passing storm conditions, blow with considerable frequency from southerly directions, and thus carry the warming influence of the Gulf of Mexico far northward. These warm spells temper the winters of the northern districts, interrupting the severe cold which comes from the northern continental interior. In summer, these southerly spells are hot, muggy, and depressing. The sharp contrast between the weather type which is associated with cold northerly winds, and that which comes with warm southerly winds from the Gulf, is one of the striking and characteristic features of the climates of much of the great region east of the Rocky Mountains.

The Great Lakes are of relatively subordinate importance as climatic controls, but they show local effects which are in many cases of distinct economic significance. The lee shores in several cases show heavier annual rainfalls than the windward shores. Local topography is here, as always, an important factor in controlling the amount of rainfall. The belt between the 30-inch and the 35-inch mean annual rainfall lines shows a rather significant widening toward the Lakes. This fact, together with the general trend of these, and other rainfall lines in the Great Lakes region, indicates that the lake influence is present, although not very striking. The rain-bearing winds in this district are to a considerable extent from easterly directions, and for that reason the slight difference in rainfall between

* The mean surface temperature in February averages between 68° and 77°, and in August, between 82.5° and 84°.

windward and leeward shores is not surprising. In winter, when the cold westerly winds sweep across the open waters of the lakes, the snowfall on the lee shores is distinctly increased.

Other effects of the Great Lakes are the decreased intensity of severe winter cold waves resulting from the tempering influence of the water; the later occurrence of the first killing frost of autumn and the earlier date of the last killing frost of spring in favored localities, as in the famous Chautauqua grape belt; the development of onshore lake breezes on fine, hot summer days, as studied at Chicago; a local increase in cloudiness and in relative humidity, and some other minor effects. Details concerning these conditions belong in a study of local climates, and are out of place in a broad consideration such as the present one.

Mountain Barriers.—Mountain ranges are effective climatic barriers, especially if near a windward coast. The most important mountain barrier in the United States is that formed by the Pacific Coast ranges (Cascades, Sierra Nevada, Coast). These mountains prevent the influence of the Pacific from being carried far into the continent, and thus separate a narrow coastal belt, much of which has a modified marine climate, from an interior, east of the Sierra Nevada-Cascades, where the rainfall is less and the ranges of temperature are much greater. The influence of the western barrier upon the climates of the North American continent as a whole is accentuated by the fact that the mountain systems trend in a northwesterly direction in the higher latitudes, where the continent broadens, thus limiting the marine influences still further to the more immediate Pacific coast. The situation is quite different in Europe, where there are no high west coast mountains and where, for this reason, and because the windward margins of the continent are much indented by numerous water bodies, the ocean influence is carried far inland by the prevailing westerly winds. The Rocky Mountains, together with their collateral ranges, are far less important as a climatic barrier

than they would be were there no Pacific ranges. The latter, being farther to windward, naturally have the greatest effect. The influence of the Rocky Mountains is seen in their local effects upon rain and snowfall; in their acting as a barrier against the spreading of cold waves over the plateau region from the east; in the warming which bodies of air undergo as they descend the slopes (chinook winds); in the differences which often prevail between the weather types to the east and west of the continental divide, and in other ways.

The Appalachians as a whole are not an effective barrier. They are not high. They are near the leeward margin of the continent. They are more or less parallel to the direction of the prevailing winds during much of the year. The amounts of rainfall on their eastern and western slopes do not, taking the system as a whole, show very marked and persistent differences. Even in winter, they do not protect the districts to leeward from invasions of continental cold. The Appalachians do, however, show many local barrier effects upon the climates of their immediate surroundings. The fact that the lesser mountain barrier is on the east of the continent, and the greater barrier on the west, made it easy for the early settlers to cross the Appalachian area through the natural gateways, and then to expand over the great interior lowlands, where they found favorable climatic conditions.

It is one of the striking characteristics of the topography of the United States that there is no great transverse (*i.e.*, east and west) mountain barrier. In going from south to north, or *vice versa*, no sudden changes in climate are met with. The gradations are slow and gradual. The natural climatic subdivisions are, therefore, separated by meridianal, and not by latitudinal, lines. The influence of the Gulf of Mexico would be much diminished if there were a transverse range of high mountains across the Mississippi valley. Such a range would cut off from the districts to the north of it the warm southerly winds and the rainfall which now have free access from the Gulf. The

severity of the winters would therefore be considerably increased over the northern tier of States east of the Mississippi River. A transverse mountain range, on the other hand, would be a great protection to the southern States in winter in keeping out the cold northwest winds, which now have a free sweep from the western plains of Canada to the Gulf, and often cause damage to crops in the far south. The significant fact concerning the topography of the eastern United States as a whole is its uniformity. There is some analogy with the conditions over much of Europe, where the mild and damp southwesterly winds from the warm Atlantic temper the winters in a similar, though much more marked way.

The fact that the western mountain barrier largely prevents the importation of water vapor from the Pacific Ocean into the interior adds very greatly to the importance of the control which the Gulf of Mexico can exert over the rainfall of the eastern United States. From the Gulf comes an abundant supply of rainfall, which to a large extent compensates for the loss resulting from the presence of the western mountains. Were there no western mountain barrier, the Gulf, while still of importance, would be a less critical control. In Europe, where high western mountains are lacking, the supply of water vapor from the Atlantic is freely distributed to the eastward, over the continent. There is, therefore, no such need of an auxiliary supply from the Mediterranean. If there were no Gulf of Mexico, or if there were a high transverse mountain barrier across the Mississippi Valley, the rainfall over much of the United States east of the Rocky Mountains would doubtless be far less favorable for agricultural purposes, and for the settlement of a large population. Indeed, it is probable that semi-aridity might to a considerable extent replace the present sufficient and well-distributed rainfall over much of our best farming land.

Altitude.—The barrier effects of mountains are simply due to the obstacle that mountain ranges put in the way of climatic conditions which would otherwise be similar on the opposite

sides of the barrier. A narrow wall, as high as the respective mountain ranges, would accomplish essentially the same results. In addition to this simple barrier effect, mountains and highlands have certain special climatic peculiarities because of their elevation above sea-level. It is here that the control of climate by *altitude* is met. Mountain and plateau climates are always placed in a group by themselves, as distinguished from those of lowlands. The former, as contrasted with the latter, are characterized by a general decrease in pressure, temperature and absolute humidity; an increased intensity of insolation and radiation; larger ranges in soil temperature; higher wind velocities; usually a greater frequency of rain and snow, and, up to a certain altitude, more of it. "Inversions of temperature" (*i.e.*, when the temperature *increases* with increasing altitude) are frequent characteristics of the colder months, and of the night. Such conditions often give mountains the advantage of higher temperatures than the adjacent valleys or lowlands,—a fact of importance in connection with the use of certain mountain stations as winter resorts. In summer, altitude tempers the heat of the lowlands. Broad generalizations such as these serve only for the purposes of a very brief summary. The local topography is of prime importance in bringing about many modifications in climatic conditions. Mountains both modify the general, and give rise to local, winds. Among the latter, the well-known mountain and valley winds are often of considerable hygienic importance in their control of the diurnal period of humidity, cloudiness and rainfall.

In the United States, the greatest and most widespread effects of altitude are naturally found in the western plateau and mountain region, where the varied topography gives rise to a great variety of local climates. In the east, the elevations are less, and the area occupied by highlands is less extended. Nevertheless, there are many well-known conditions which result from the presence of mountains. Among these may be mentioned, as illustrations, the heavy rainfalls of the eastern and

southern slopes of the southern Appalachians; the popularity, as summer resorts, of the White Mountains of New England, the Adirondacks of New York, and many other portions of the mountain and plateau country along the Atlantic seaboard. If there had been no Appalachian highland area in the Southern States, with its plateaus and slopes unsuited to the growth of tobacco and cotton and sugar cane, these typical southern crops, and the negro labor which they necessitate, would doubtless have occupied much of the area which, with its more "temperate" plateau and mountain climates, was actually settled by a very different sort of population, engaged in different occupations.

Prevailing Winds.—Most of the United States lies in what is generally known as the belt of the storm-bearing "prevailing westerly winds." To the south, the States bordering on the Gulf of Mexico share in the wind system which is characteristic of tropical countries, viz., the trades. These trade winds, like the "prevailing westerlies," find their initial cause in the great permanent differences of temperature and of pressure between equator and poles, but are greatly modified by local pressure distribution. Year by year the succession of the seasons brings a warming and a cooling of the continent. The pressures change systematically, not only over the continent, but also over the adjacent oceans. Sympathetically, also, the prevailing winds show a seasonal change in their directions. Other influences also play a part. The great mountain systems are barriers in the path of the winds. The general configuration of the country; the trend of mountains and of valleys; locations to windward or to leeward of mountains or of lakes; the hour of the day or night; exposure to land or sea breezes; and, more important than all, the varying storm control—all these have a share in controlling the winds, both in direction and in velocity. And as winds are of critical importance in controlling weather types, the direction and velocity of air movement, however controlled, is fundamentally important in any study of climate. The "prevailing wind" in summer may be a very warm one, as is the case over most

of the eastern United States, where southwesterly wind directions are then dominant. Or, the prevailing winter wind may be a a cold one, as in New England, thus making the winters more severe. The reversal of the "prevailing westerly winds" under the control of passing conditions of high or low pressure is so frequent that many persons, especially along or near the northern Atlantic coast, find it difficult to believe that the "prevailing winds" are actually from the west. Easterly storms; easterly winds blowing on-shore from a high pressure area off the coast; even the local and relatively insignificant sea breeze of summer, all combine to keep up this impression.

The great permanent areas of high and of low pressure over the oceans adjacent to North America, the so-called "centers of action," play a considerable part in determining the directions of the prevailing winds on the continent. The marked low pressure system over the northern North Atlantic ("Iceland Low") exerts a distinct control over the prevailing northwesterly winds of the northeastern United States in winter. The tropical high pressure belt of the North Atlantic ("Bermuda High") has an important share in determining the great flow of southerly winds over the southern and eastern portions of the country throughout the year, as well as in controlling the general character of the seasons in the eastern United States. On the Pacific coast, a low pressure area over the Northern North Pacific ("Bering Sea Low") in winter largely controls the prevailing southwesterly and westerly winds of the northern portion of this coast, while the tropical high pressure belt, lying farther south, also influences the wind directions, especially along the southern portion of the coast.

Ocean Currents.—Too much emphasis is usually laid on ocean currents as controls of climate. It should be remembered that an ocean current can have practically no influence on the climate of an adjacent land unless the wind is blowing onshore, and, further, that ocean waters in themselves, without the help of any ocean currents, are conservative bodies, and therefore tend to

temper the cold or the heat of any land over which their influence may be carried. It is true enough that the Gulf Stream does keep the North Atlantic waters off the eastern coast of the United States warmer than they would otherwise be, and that the Labrador Current is a cold flow which chills these same waters to a lower temperature than they would otherwise have. And on the Pacific side, the Japanese Current, flowing southeastward along our western coast, with a subordinate eddy circling around the Bay of Alaska, certainly contributes toward keeping the Pacific Slope climates rainier and warmer in winter than they would be without that current. A glance at the isothermal charts of the world at once shows the effects of these currents in deflecting the isotherms. Off the Pacific coast of North America, the isotherms are carried equatorward by the southward-flowing current passing along California and Mexico, and poleward by the eddy which flows from right to left around the Bay of Alaska. The result is a spreading apart of the isotherms, and a tendency towards an equalization of the temperatures along the coast. On the Atlantic side, on the other hand, the isotherms are crowded together. The Gulf Stream carries them northward along the southern and central portions of the coast, while the Labrador Current carries them southward along the coast of New England and the Canadian Provinces. Hence there is a very rapid decrease of temperature northward along our Atlantic coast, which amounts to 2.7°F. per latitude degree in January.

Storm Control.—In the "Temperate Zones" the weather is largely controlled by a succession of low and high pressure areas ("cyclones" and "anticyclones"), more or less irregular in their occurrence; uncertain in their progression and duration; and differing considerably in their characteristics. Hence, weather changes are correspondingly irregular, uncertain and diverse. Of weather types there is an almost endless variety. These different weather types give our climates their distinctive characters, and to a large extent determine the amount and distribu-

tion of temperature; of rain and snow; of humidity; of cloudiness. Cyclones and anticyclones are, therefore, essential controls of climates in the latitudes of the "prevailing westerly" winds. The detailed study of weather types is not a part of ordinary climatological investigation. Yet anyone who seriously attempts to study the climatology of the United States will soon realize that the better his understanding of our weather types, the more intelligent is his appreciation of our climate.

The aim of the present paper is simply to enumerate the major climatic controls in the United States, and to give a few illustrations of their effects. It is in the detailed study of local climates that the interaction of these different controls is worked out, and the part which each one plays is considered.

DISCUSSION.

Dr. Carroll E. Edson: It is a matter of the greatest satisfaction to one of the older members of this Association who came into it when it was only supposed to be a climatological association to hear at the first meeting I have attended since it became a clinical association the first paper on the program on the subject which so interests us, dealing with a subject which we have for a long time needed. I think a study of the literature of health resorts would be from the point of view of strict climatology an amusing subject. There is a confusion in the popular mind, and the effect of climates on health has not been, on the whole, accurately studied. I think that the Association is indebted to Professor Ward for starting once more the discussions which are bound to come up in this Society, upon a basis of scientific accuracy for which we now have no excuse of ignorance.

Dr. Hinsdale: I want to state my appreciation of Professor Ward's very clear and interesting paper on the principles of climatology. I think we ought to pay more attention to climatology and meteorology and not forget what is really the backbone of the work that this Society has done in the past. We need papers on climatology and meteorology and especially on the health resorts and the other features which used to figure so largely in our Transactions in the early days, because when we come to a practical application of our knowledge of climatology we need examples. We want to know what we are talking about with reference to localities and their effects on health and disease. The professor made one simple statement, to be sure, but one that we often forget, and that is that the isotherms are

not at all parallel in the United States. We forget that latitude does not always govern, that altitude does not govern the climate of a place. I found that out in Hot Springs when we had temperatures lower than it was in Boston, when we had temperatures below zero in Virginia, when the destructive effects of severe cold are now evident all over our gardens in the South; and that is a thing which visitors to health resorts seem to be surprised at. They think when they go to Virginia they ought to get the oldtime climate of the seaboard and they do not realize that in the mountains things are different from what they are at the seaboard.

The professor mentioned the influence of storms as controllers of climates: That is an exceedingly interesting study—the progress of storms across our continent. We know that they travel from the west to the east. They have been known to reverse their direction. Cyclones, which is a name for these travelling areas of low pressure, have been known to come up from the Caribbean and strike the coast of Texas on a reverse curve and then swing out to the northeast to cross out to the northern Atlantic and the Gulf of St. Lawrence.

Now those studies are very interesting, and there is another matter of great interest to me and that is the occurrence of tornadoes. Professor Ward has lately published in the TRANSACTIONS of the Royal Geographical Society an interesting and instructive article on the occurrence of tornadoes in the United States that I recommend to you as an admirable article. These tornadoes which occur in the early spring and summer are sometimes experienced as far north as the Canadian possessions. There have been some very serious ones in Alberta, and we have had them as far north in the United States as New York City, and we have had small tornadoes as far north as Massachusetts.

These controls of climates by passing storms and the occurrence of cyclones and tornadoes are subjects which have always been interesting subjects to me.

DR. V. Y. BOWDITCH: It is interesting to me to note the differences of climate that can exist within a small radius, as shown in New England and the difference in the quality of the atmosphere of Maine from that in Rhode Island and Massachusetts, from a residence in both places. I think we can feel the bracing winds that come along the coast of Maine in contrast with the enervating winds.

The quality of fogs differs. In Maine you often see a dry fog floating about in the atmosphere, paradoxical as that may seem. There one can even dry clothes in a fog.

All these factors come in as adjuncts to us as to where we shall send our patients, according to the quality of the atmosphere.

DR. W. F. R. PHILLIPS: I am glad to hear the paper Professor Ward has given us and I am glad to hear some expressions to the

effect that we are still interested in climatology in the Climatological Association. I think that there is a great deal in climate, although I am not so much a climatologist as I was some years ago. I believe the proper way, however, to get at our climatological effects so far as they affect the welfare of the individual, is not by reading papers but by getting facts from experimental observation. Some years ago I endeavored to press the necessity upon our Association of taking some steps toward the establishment of a climatological laboratory. To make any progress from the climatological point of view we want biological facts and then discussions of meteorological data in connection therewith. Climatic data mean nothing unless we have biological facts on which to base them, and my only reason for discussing the matter is to stimulate the Association to establish and properly equip institutions to investigate some of the climatological facts and their bearing on the organism. If we do that, then we can discuss climatology better than we do at present. We are to be congratulated on hearing Professor Ward's excellent paper.

Dr. J. H. Elliott: It is a great pleasure indeed to have this paper from Professor Ward. I have been looking forward to it. His hand-book on climate is one of the most readable books I have ever come across, and the paper he gave us this morning has been so clear, and he has elucidated it so clearly, I think it is important for this Society to pay as much attention as possible to climatology. Now in the past a great deal of our so-called knowledge of climatology and the relation of climate to disease has been more or less empirical, but with the increase of weather observation stations, with more accurate data as regards rainfall, winds, etc., in a large number of places together with an increasing amount of opportunities for clinical investigations in various centers, we should be getting to the point where we can arrive at definite conclusions regarding the relation of climatic conditions to disease processes in the body. And I hope as years go on we shall have more and more papers which shall bring up the relation of climatic conditions to disease.

Prof. R. DeCourcy Ward: I have been much interested in the remarks. It seems to me that the opportunity to make climatological observations is good in connection with the draft army. There have been many men sent to many parts of the country, and I have wondered if it would not be a good plan to make observations of men sent from one climate to another. It occurred to me that would be an opportunity to do laboratory work on a large scale provided the men stayed long enough in any given locality.

Dr. W. F. R. Phillips, Charleston, S. C., read a paper (from manuscript) on "Patent Foramen Ovale and its Relation to Certain Cardiac Murmurs."

PATENT FORAMEN OVALE AND ITS RELATION TO CERTAIN CARDIAC MURMURS.

By W. F. R. PHILLIPS, M.D.,

Charleston, S. C.

During the academic sessions of 1916–17 and 1917–8, there were dissected in the regular courses of anatomy of the medical school with which I am connected twenty-three adult cadavers. The hearts of all were examined with reference to the existence of any direct communication between the right and the left atria, either as caused by the persistence of the foramen ovale or by defective development of the interatrial septum.

In eighteen of the twenty-three hearts, a direct communication was found and in five of the twenty-three there was no such communication. With but one exception, the right orifices of the communications were in the fossa ovalis: in the exceptional case, the right orifice was in the limbus foraminis ovalis. The left orifices of all were within the area of the left atrium that corresponded to the area of the limbus and fossa ovalis of the right atrium. The location of the right orifices was variable but generally in the upper half of the fossa, and often so covered by the projecting border of the limbus that the orifice escaped notice on superficial examination. On the left side the orifices of the communications were placed either more cephalically or more ventrally than on the right side, so that the passageways ran obliquely through the membranous floor of the fossa or between it and the limbus. In length, the passageways varied from oblique slits to channels of some length, several being about three quarters of an inch from orifice to orifice. Some of the long channels showed *cul de sacs* extending from them. The caliber of the communicating openings varied from pin-hole to pencil-size or larger in diameter, one was large enough to admit

the passage of the tip of the little finger. The shape of the openings on the right side was equally as variable as the locations; some were mere slits with slightly rounded margins, others dimple-like to funnel-like depressions, and others of irregular shapes. On the left side the openings were more regular and tended to resemble more or less the orifices of the foramina of the small cardiac veins. In several instances two openings occurred and in one case a forked channel, having one orifice on the right side and two on the left, was observed. The variability in location, shape, and size of the openings appeared insusceptible of classification into types. From the oblique course of the openings, all were valvular in action, permitting fluid to flow through them only in one direction and this was from the right atrium to the left atrium, with the exception of the opening located in the limbus; this opening permitted fluid to pass only from the left to the right atrium. The ages of the cadavers, as judged from appearances, were from young adult to advanced life. The clinical histories of all were unknown. All the openings observed were unquestionably failures of the foramen ovale either to develop normally or to close normally after birth and, therefore, are to be regarded as cases of patulency of the foramen ovale in adult life.

The fact that such patulency was frequent has been remarked by anatomists and by pathologists from time to time and with more or less emphasis; it has been commented on also by clinicians but with less frequency and decidedly less emphasis than the prevalence of the condition deserves, at least such is the impression given me by an examination of some of the current text and reference works. The series of hearts here reported shows a ratio of persistency as against complete closure of the foramen ovale of 18 to 5, or 78 per cent. persistency to 22 per cent. closure. This is a ratio greater than any other so far within my knowledge. There appears to be wide variability in the observed frequency of unclosed foramen ovale in adult life. Quoting but a few among the relatively recent writers referring to the subject:

Cunningham[1] gives the ratio of patency to closure as about 1 to 5, that is about 20 per cent.; Parsons and Keith,[2] as over 26 per cent. as determined from a collective investigation of 399 hearts; according to Welch and Rolletson,[3] Firket reported the foramen unclosed in 34 per cent. of his cases; Sewall[4] quotes Hochsinger as authority for stating that Kolb and Wallman found the foramen persisting in no less than 44 per cent.; and Babcock[5] states that according to Romberg the foramen persists in at least half of all cases. It may be interesting and not inappropriate to notice some of the non-statistical observations of a few of the earlier writers mentioning the persistence of the foramen ovale in adult life: Andrew Blake,[6] in reporting a case in 1828 of foramen ovale, found open in a soldier dying of tuberculosis, quotes "that able anatomist, the late Mr. Shaw" as having observed that the condition "is so common that we cannot attach much importance to it." Farre,[7] in 1814, writes: "In considering the structure of the fœtal heart, the probability would seem great, that the valve of the foramen ovale might frequently be imperfectly united to the annulus foraminis ovalis by the pressure to which it is subjected in the double circulation after birth. But, yielding up probability to anatomical demonstration, an aperture of communication through the septum auriculorum is actually so often met with in subjects brought into dissecting rooms attached to the anatomical schools, that the observation of the student who has not witnessed it, even in adult life, must have been exceedingly limited." Allan Burns,[8] in 1809, remarks that "We very seldom find the foramen ovale and the ductus arteriosus both open, but we very frequently observe the foramen ovale pervious even in very advanced age." In the second edition of his "Traite de la Structure du Cœur," published in 1783, Senac[9] states: "Ce trou, bien loin d'etre bouche dans l'adulte, est ouvert dans la plûpart des sujects, méme de ceux qui sont parvenus à une extreme veillesse." While Le Cat[10] is quoted in 1741 as follows: "This last winter I had opened a great number of dead bodies of men grown, and did not find the foramen ovale open in any of

them. The oldest male subject in which I found it open was a lad of fifteen years of age. Of twenty bodies of women, which I examined, in seven I found the foramen ovale open. Among the number of openings that remain of this foramen, there is a great variety in their shape, and in the number of cicatrices or adhesions of the valve." Le Cat then describes and figures three general types to which the openings may be reduced. Cheselden[11] in 1722, in describing the method of closure of the foramen ovale by the adhesion of the valve, observes: "Sometimes this valve does not quite cover the foramen, in which case a small quantity of blood may possibly flow from the left auricle to the right, and so circulate twice through the lungs to once through the body, but none could flow from the right to the left and escape the lungs, which might be a bad consequence. Some have imagined, that men who have this passage open, cannot be drown'd: but though this passage has sometimes been found open, no man has been yet seen, that we have heard of, that could not be drown'd. I have seen the foramen open in a man that was hanged, to whom one might justly expect it should have been as useful as in the case of submersion."

All the subjects examined by me were negroes, showing less racial admixture than that of quadroon; it may be, therefore, that this increased ratio is a racial characteristic, but this is not to be considered as other than a very contingent explanation. I am inclined to think that present day anatomical methods of preserving material, and the more leisurely and critical examination that such methods permit, will enable the finding of openings that in the ordinary postmortem procedure of examining fresh and unfixed hearts may easily be overlooked, and that the larger ratio I have found is due to dissecting room methods of examination.

The series of hearts herein reported is small numerically and I should hesitate to depend on it as an index of the frequency of unclosed foramen ovale in the adult were it not more or less supported by the observations of others, and also by my own

impressions drawn from an extended anterior, but unrecorded, experience in dissecting room work. The fact that such openings are frequent, almost the rule rather than the exception I am tempted to say, would appear to attach to them a clinical interest that they have not heretofore had as probable, and doubtless, frequent, factors in the causation of cardiac murmurs, and particularly of that class of systolic murmurs unassociated with any other evidence of cardiac impairment. The frequency of the occurrence of these openings through the fossa ovalis in adults of all ages and their almost invariable valvular nature, indicates that they are not inconsistent with perfect cardiac function, and that so far as constituting a pathological condition they are virtually, as Humphry designates them, "without clinical significance." However, as factors that may and do cause unquestionably now and then signs that may be mistaken for those of pathological changes in the heart they are worthy of consideration.

The variability observed in the position, caliber, shape, and length of these openings, to which reference has already been made, would indicate, *a priori*, great variability in the physical evidences, as murmurs, that may be due to the existence of these openings. It is not surprising, therefore, that the clinical signs of these openings are not better understood at present. Romberg, according to Babcock,[5] states that the bruit caused by an unclosed foramen ovale is usually a loud systolic murmur, heard throughout the cardiac area, particularly over the base and apparently not limited to any area. Humphry[12] groups the auscultatory sounds of all septal defects together and writes that "on auscultation there is commonly heard to be a loud, long, systolic murmur which can be traced with varying intensity over the whole of the precordial region, over the back of the chest, and is conducted widely in all directions." According to Hirschfelder,[13] "occasionally there is heard a well-defined presystolic murmur which is maximal" over the left third intercostal space, "and which when present is the most characteristic

sign of the open foramen ovale." Thomas Oliver[14] describes the murmur as soft systolic, over the mitral area, loud, blowing, and somewhat rasping, over the base of the heart and mid-sternal area, faint as the aortic area is approached, loud and prolonged as the pulmonary area is approached, along which the murmur is conveyed for about half an inch. Sewall[4] reports the case of an infant, apparently less than a week old, clinically diagnosed as patent foramen ovale and the diagnosis confirmed subsequently by autopsy. In Sewall's case the "murmur was heard with the first sound of the heart, and was short, faint but distinct. The murmur was heard most distinctly in the segment which included the base line of the heart and curved over the right border of the sternum. In other words, the murmur had its greatest intensity in the area of the chest wall most closely approximating the auricles. Again the murmur appeared to be presystolic both in time and character. That is to say, in contra-distinction to systolic murmurs. Its ending was abrupt, not gradual, its accent was acute, not grave."

The want of conformity to definitiveness of type, or types, in these openings in the fossa ovalis, whilst it renders the certain recognition of their presence very difficult, sometimes doubtless impossible, and in so doing divests them of the clinical significance attaching to definitively recognizable conditions, yet it invests the significance of cardiac murmurs and their accurate determination and discrimination with a greater degree of importance and responsibility. In the light of the probability of openings of the kind herein described, cardiac murmurs, especially systolic ones, unaccompanied by other corroberative evidence of functional impairment become less indicative of real cardiac incapacity. How many healthy hearts have been doomed because of murmurs caused by open foramen ovales no one can say; one may guess. Apart, however, from any relation to cardiac murmurs, the frequency of openings in the fossa ovalis has a clinical importance not lightly to be passed by, and that is that these openings are potential avenues for the passage of

emboli from the venous circulation directly into the arterial circulation, the so-called "paradoxical embolism" of Zahn. That emboli do so pass has been demonstrated. Therefore, a foramen that does not invariably and completely close is always a menace, according to its degree of patulency and the occurrence of conditions favoring thrombosis and embolism in the venous side of the vascular system. It is also interesting, if not worth while, to quote Allan Burns' observation regarding the association of open foramen ovale with cardiac asthma; "This," says Burns, "is a much overlooked cause of dyspnœa, but still it is one you will very frequently be called on to remove; I have seen many examples of this kind of asthma, and have ascertained, by dissection, the real cause of the symptoms."

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DISCUSSION.

Dr. R. H. Babcock: I am very much interested in this paper of Dr. Phillips with reference, as he says, to the possibility of murmurs,

but still more I am impressed by what he said as regards it being a possible route for the passage of emboli. I can conceive that many of these patent foramina give no evidence, because most of them, as Dr. Phillips states, are very small—from the size of a pin-head to that of a pencil, and being oblique. It seems to me if a patent foramen ovale is to produce a murmur and give clinical evidence of its presence, the opening would have to be sufficiently large and sufficiently direct to permit a stream of blood passing through it to generate audible vibration. Furthermore the possibility of recognizing the size and patency of a foramen ovale is slight because, as we know, in this country very few of our cases come to autopsy. The recognition of the murmur due to patent foramen ovale I can conceive theoretically to be very difficult, and we have few cases reported, and we have very little to distinguish whether a murmur belongs to a patent foramen ovale or to something else. The paper tends to confirm a view that I have been gradually coming to, that functional murmurs, so-called, by which we mean really inorganic murmurs or murmurs not producing recognizable pathological changes in the heart, are relatively infrequent. I do not know how we are going to determine whether these patent foramina have any influence or not. Unfortunately, as Dr. Phillips states, there were no histories attached to his cases, and that is the difficulty; we do not get histories of these patients who through life show some obscure murmur whose significance we could not recognize.

Dr. J. H. Pratt: The common functional murmur, as we all know, is systolic in time. In fact, we know little or nothing about diastolic functional murmurs. If it is a diastolic murmur it is assumed to be due to valvular disease, but as a matter of fact, by careful study we can demonstrate evidence of heart disease in addition to the murmur in cases in which we hear a diastolic murmur. Now if the passage of blood from one auricle to another occurred through the patent foramen ovale, would not that take place in the systole of the auricle, in other words, would not the murmur produced by the patent foramen ovale be presystolic or late diastolic? I wish Dr. Phillips could state his views in regard to the time of the murmur.

Dr. J. H. Elliott: The paper opens up a fruitful field for discussion, and if anybody has observations either clinical or pathological, I think it would be well to have them brought out in the discussion.

Dr. R. H. Babcock: I just recall one case in which I tentatively diagnosed a patent foramen ovale but I never knew whether it was or not. It was in a female who had a peculiar murmur that seemed to be presystolic. The murmur should have occurred during the contraction of the auricle, but in this case there was no demonstrable

change in the ventricle, but there was great dilatation of the two auricles, of the left auricle particularly; and the murmur was located over the upper portion of the sternum and did not seem to correspond to anything I had ever heard, and I tentatively made the diagnosis of patent foramen ovale. Whether she had it I don't know and I am in doubt. It seems to me the contraction of the auricle would have to be vigorous to produce a murmur. Would the contraction of the right auricle be sufficiently strong to give a murmur preceding the ventricular tone? We can theorize all we want to, but I think that is all we can do.

Dr. Cleveland Floyd: Whether we can explain the numerous functional murmurs which we find in hearts by means of some organic or improper development of the heart is a question. Most of the functional murmurs we have run across have been systolic in time, and we may find them at one time under excitement and at another time not, whereas if they are explainable by a patent foramen ovale would not they be present all the time? Possibly in excitement the foramen may be stretched open with a dilatation of one part of the heart so that the murmur is heard. To detect such slight murmurs which could be produced by a slight opening of the foramen we need a better stethoscope than is now manufactured; and we have one man in Boston who is making studies of this thing, named Parker, who has an instrument which I hope he will demonstrate to this Society. It seems to me by the work he is doing, we may be able to detect murmurs which we are not able to detect at the present time.

Dr. Phillips: My purpose in bringing this paper was simply to impress upon this Association and others the fact which is current that the foramen ovale is always closed after birth. I think that is a current impression; and it was my impression for a long time until I went into a study of the hearts as seen in the dissecting room. The main thing that incited me to bring this paper before you was a thing that happened a few years ago when a physician, taking a post-graduate course in my department, found in the heart a large opening. When I told him that I observed them very frequently and that I did not consider them curiosities, he seemed very much astonished. The specimen was shown the local medical society and the members present seemed to be of the impression that a patent opening or any opening in the fossa ovalis was to be regarded as pathological.

I had gone along for a number of years seeing these things but not recording them, this incident caused me to record them, and in twenty-three hearts exposed we found eighteen of them with openings. That was a larger percentage than had been before reported, and the explanation of that percentage is due to the fact that we now use in our anatomical departments a preservative that fixes the heart and enables

the examination to be carried on leisurely and enables a very critical examination to be made. I am fairly convinced that if all hearts were examined with the same care, we would find these openings the rule rather than the exception.

As to the action—the physics the condition—I would not like to impose upon your time in going into it. I want you to bear in mind that the heart is fixed at the base, that the intra-atrial septum is virtually free so far as regard fixation. If this represents the dorsal portion of the heart (illustrating by design on black board) and here is the base of the heart, the intra-atrial septum and the cava above and below fastening it so that it is held in a vertical position. Virtually the whole pull on that heart has got to pull on this point here, and here is the fossa, and here the limbus more muscular than anything else in the septum. That heart has got to shorten itself. The pectinate muscles have got to shorten, and the whole effect is to cause the heart to relax and make any opening in the fossa patent. Any opening in the fossa in contraction of the heart would become wider and wider so that if the pressure on one side varied from that on the other the blood would pass through it.

Some time I hope to elaborate my ideas on the physics of the situation. Dr. Pratt asked whether the murmur should be systolic or presystolic; I am not clinician enough to distinguish between systolic and presystolic murmurs. I can only say this: After having examined a great many hearts, when I find a murmur in the heart I am going to say it is due to some physical or some pathological thing in the heart. I do not believe that we will find such a thing as a functional murmur unassociated with a physical basis behind it.

Dr. John L. Heffron, Syracuse, N. Y., read a paper (from manuscript) on "The Significance of Early Heart Lesions."

THE SIGNIFICANCE OF EARLY HEART LESIONS.

By JOHN L. HEFFRON, M.D.,

Dean and Professor of Clinical Medicine of The College of Medicine of Syracuse University.

In no department of internal medicine has there been during the last two decades a greater advance in knowledge than in that of diseases of the heart. Important discoveries in the anatomy and in the physiology of the normal heart have contributed greatly. Research work in bacteriology has demonstrated that very many disease-producing bacteria besides those formerly recognized as causative agents are capable of invading the heart in the course of an infectious disease, and it is generally agreed that the cause of rheumatic involvements is bacterial, though it can not be said today that there is unanimity amongst bacteriologists on its identity. Pathologists have demonstrated that the cardiac lesions due to infections not only are not confined to the valvular structures of the heart, but that the invasion of the musculature of the heart is of much more significance.

By the use of the newer graphic, illuminating and acoustic instruments of precision more exact observations have been recorded and by their help the entire subject of the cardiac arythmias has been clarified and rewritten in a form that seems permanent. All of these advances have made possible a surer prognosis. The heart today is considered to be an organ which can withstand serious pathological injuries and yet regain and maintain a considerable degree of power.

Many of us in this society were educated when the teaching concerning the relative importance of valvulitis was exactly the opposite of what it is today. We were taught the pathological changes in valves and the doctrine of the backset of the blood and were carefully drilled in the detection of murmurs

and their exact location, and in the tracing back of the damaged valve the effect upon the general circulation and on the integrity of various organs. Very little was taught about the muscle of the heart. The modern conception of the physics and pathology of the heart is quite different. The clinician estimates at the bedside the contractibility, the excitability, the conductivity, the rhythmicity and the tonicity of each heart he studies.

The driving force of the heart due to its muscular contractions is the most important. If the driving power of the ventricles be efficient, the circulation is maintained. In a disabled condition of the heart muscle, it is the failure of the forward propulsion of the blood, not back pressure, which retards the circulation and thus disturbs the function of organs, permits the collection of blood at the doors of the auricles, and makes œdema possible. Heart disease as a whole may be considered as a disturbance of the driving force of the heart muscle.

The force of every heart is a personal one and must be measured by the maximum amount of work which an individual can do habitually with perfect comfort.

A heart capable of exerting its maximum force with perfect comfort is of normal size, and of normal rhythm and of normal rate. Any departure from this standard must of necessity change the classification of the heart presenting it.

The size of the normal heart is practically constant. It is accurately ascertained by an x-ray examination. It can be determined with relative accuracy by correctly locating with the stethoscope the apex beat and the second sound at the aortic cartilage. Palpation and percussion are valuable but less precise. The heart undergoes both hypertrophy and dilatation from causes outside of the heart. When such conditions are eliminated and the heart is still found enlarged or dilated it is of itself an indication of a fault which must be explained.

The rhythm of the normal heart is exact, except in childhood and in adolescence. Sinusarhythmia is but evidence of an instability of nerve control normal to those periods of develop-

ment. Paroxysmal tachycardia, observed often in toxic states or even due to pressure from a stomach distended with gas or overloaded with food, particularly in the neurotic, is common. We have been in the habit of ignoring this symptom and it is of relatively little consequence. In chronic toxemia, as in Bright's disease, it adds to the embarrassments already existing. Premature contractions never fail to make themselves known to the consciousness of the patient. They are startling at first because of the heavy thud of the delayed beat. Premature contractions have been observed in those who otherwise have seemed perfectly normal. Auricular fibrillation and auricular flutter are of more significance. The advent of either one of these irregularities is positive proof of a considerable enfeeblement of the heart muscle. In some cases activities can be maintained and a comfortable life enjoyed for many years, but the average lease of life after the establishment of one of these irregularities, which, as a rule, is permanent, is not more than ten years. Either may accompany another cardiac lesion, particularly mitral stenosis, but either can develop independently of other involvement. Cases in which paroxysms of tachycardia have later been accompanied by premature contractions, and ultimately developed suddenly auricular fibrillation are already recorded and have undoubted significance. From those presenting such a series of phenomena one rarely fails to get the history of some infectious disease occuring in the early years.

J. P. at twelve was an unusually well developed boy. He had had many severe infectious diseases, including diphtheria, pneumonia and typhoid fever, but without known cardiac involvement. After severe exertion he developed symptoms of heart failure, and dilatation and mitral murmur were discovered. A short period of complete rest restored the heart to an apparently perfect condition. In early manhood he had many brief attacks of paroxymal tachycardia attributed to errors in diet. At about thirty an occasional premature contraction was noticed, but he was not inconvenienced. In the forties these attacks increased

in frequency and were thought to be longer when too much tobacco was smoked. At forty-five, while exercising, he suddenly developed auricular fibrillation with a very rapid pulse. Under rest and digitalis the irregular pulse was brought down into the seventies and has been kept there. With care he is able to do a considerable part of his work as a counsellor at law. I have observed this case for some years and can detect no advance so-far. There is no accompanying cardiac lesion or other complicating pathological condition.

Heart block is interesting and of importance in prognosis when progressive. A complete heart block, if the pulse be not reduced below the limit at which an uninterrupted circulation in the brain can be maintained, need not shorten life greatly. In a woman under my observation for minor ailments throughout my entire practice and now seventy-six, complete heart block with a pulse of 38 to 40 has been known to exist for at least five years. She is still active and doing her own housework for a family of four adults. On two occasions, when overexerting herself, she has lost consciousness for a period just long enough to fall and she has had more frequent dizzy spells. She had rheumatism early in life and phlebitis repeatedly in later years, but valvulitis can not be diagnosed from any murmur. Her heart is moderately hypertrophied. Her blood pressure is 170/80 and her hæmoglobin is 80.

True pulsus alternans is always of grave significance. It usually expresses extensive degenerative changes and feebleness of the heart muscle. The majority of cases with this symptom do not survive two years.

The heart has a normal rate of contracting. A rapid pulse is one of the manifestations of a weakening muscle, but there are so many physiological and pathological conditions that are expressed by an increase in the pulse rate that it is always necessary to exclude extracardiac causes before considering the rate alone as a factor in prognosis.

That a heart of normal size, rhythm and rate may present

murmurs is a common observation. In many perfectly healthy young men a murmur may be heard at the situation of the pulmonary artery, due to a slight contact of that vessel with the chest wall. Cardio-respiratory murmurs, superficial, heard along the left costal arch, like a puff of air pushed out of an overlapping tongue of lung by each stroke of the heart, are relatively common. Functional murmurs due to temporary causes are not uncommon but require careful differentiation. All of these are of no prognostic significance. But murmurs are heard at the apex, systolic, presystolic or diastolic and at the aortic cartilage systolic or diastolic which are significant of valve lesions, even though the heart be of exactly normal size and function.

The noisiest murmur is not usually the one of most importance. One finds an aortic regurgitant murmur at times that is loud, but not accompanied by evidence of disturbance on the part of the heart. But even a prolongation of the second sound at the apex with a suggestion of a change in the tone, if accompanied by a fine thrill at the apex, is indicative of a beginning mitral stenosis and is of the utmost importance, however perfectly the heart muscle is doing its work. Mitral stenosis is a defect ultimately attended by grave consequences in every instance. Mitral regurgitation, however, is a condition to which the heart can accommodate itself perfectly for many years.

A young man of twenty-four came to me recently, saying he had been refused for military service on account of his heart and because of under weight. He also said he fainted easily. He did not know that he had had heart disease, but he gave the history of infectious diseases, including tonsilitis, in childhood. He was perfectly proportioned, but was six pounds under the average weight for his moderate stature. He was very highly organized nervously. His heart was exactly normal in size, regular, of normal rhythm and rate and his blood pressure was normal. At the apex there was a loud systolic murmur propagated to the left to the mid-axillary line. After exercise the proportionate increase of rate was no more than normal. On questioning him,

it was developed that his fainting spells had never occurred except when his imagination had exaggerated the effect of a gruesome recital—as Billy Sunday's sermon to men, an orator's description of the carnage of battle, etc. If he had been up to normal weight and I had been examining him for military duty, I should have been obliged to pass him. It was perfectly evident, however, that he had had mitral valvulitis with little or no impairment of the muscle of his heart.

At fifteen C. F. had a savage attack of acute articular rheumatism with carditis, and that passive congestion of the lung often called pneumonia. He was confined to bed about three months. For a long time the persistent symptoms of cardiac impairment were in evidence. The heart finally became strong, the various evidences of impairment receded and disappeared to such an extent that ordinary methods of examination did not reveal a murmur except after most violent exercise, and even then there were no other evidences that the heart was not up to its job. He escaped further illness. He went through college and through a medical school with credit. He passed an exacting examination for life insurance. When he was twenty-five and an interne in a hospital, he contracted an acute infection of first one and then of the other tonsil without suppuration. After a couple of weeks, during which his heart had remained as before, he got up, was about a few days, and then developed an acute, toxic, ascending, multiple neuritis. His heart was watched with great care. It gave no evidence of a re-infection, but with added weeks in bed, and possibly from the influence of the toxins producing the neuritis, his heart became dilated and rapid and the same old murmurs reappeared. The neuritis ran its course rather quickly for such an extensive involvement. At the end of four months from the initial infection the dilatation had diminished so that the apex was inside the mid-clavicular line, the rate was in the seventies while at rest, and the murmur was faint. It is probable that he will regain good muscular tone, and that he will be able to engage in the activities of his chosen profession.

G. S., forty-three, a farmer consulted me because, as he said, "My wife complains that my heart makes so much noise that she can not sleep." He had had no illness but influenza ten years ago. For the past year he has noticed a noise in his heart, that it is heard when standing and when lying and that it is becoming somewhat louder. The heart was exactly normal in size, his pulse was 68 and his blood pressure was 145/45 and his hæmoglobin 85. Heard plainest at the aortic cartilage in diastole there was a musical murmur like the twang of a high pitched string of a violin. It really was transmitted so that it could be heard by anyone standing near him. The pulse was collapsible, as indicated by the low diastolic pressure. This man had done all the heavy work on a farm all his life, and came not because he felt ill, but because he was curious to know what the noise was and what it meant. There was no doubt but that he had aortic regurgitation with possibly a rent in one of the cusps.

A. P. came under my care for varicose veins when he was sixty-three. He was born in England and began life as a blacksmith. He knew he had a heart lesion early in life and on that account had educated himself for business and became an iron manufacturer and at sixty had retired. With every beat of his powerful heart his whole body reacted. The arteries were greatly dilated, the ascending palatine being as large as "night crawlers," and writhed from their beds with each pulsation. His heart was hypertrophied with apex inside the mammary line. It presented a mitral systolic and an aortic diastolic murmur of great intensity. His pulse was always in the seventies when at rest, and never above 100 after exercise. Four years later Dr. Jacobson did a Whitehead operation for the removal of the pile-bearing area under ether which he took without trouble. At the age of seventy-six, after a siege with whooping cough contracted from a young member of the family, failure of heart supervened, rapidly progressed and terminated a life that had been tolerable and not devoid of usefulness.

In my early practice I saw many men who worked in the salt yards. These men were always exposed to wet weather and their work made necessary strong use of the muscles of the arms and trunk. In routine examinations, the hearts of these men were almost always found to be hypertrophied, often more or less irregular and sometimes gave various murmurs. It made one wonder, at that time, that their work could be continued, but, as the heart condition was a discovery which had little to do with the illness for which treatment was required, nothing was made of it, but observations were continued sometimes over a considerable period. Many of these attained a good age and comparatively few of them died because of heart failure. In thirty-seven years of practice a considerable number of cases of acute heart disease has come under my care and some of them have been observed for many years. Of these who have survived the initial shock, the majority have gone on with their chosen work successfully and with considerable comfort.

Very many of the adults who come to the consulting room with some form of cardiac impairment, come without previous knowledge of an existing heart lesion, but I suspect that the great majority of the cardiac lesions that limit activities beyond the meridian of life trace their beginnings to childhood or to the adolescent period when infections are common. It is certain that very many cases of infectious disease in childhood involve the heart without recognition. In rheumatism and in scarlet fever the heart is usually watched with care, but in the other infections, all of which are potential causes of heart lesions, we had not been taught to be so careful. Another thing is certain, a destructive process, however slight, leaves a scar. No one who has studied preparations showing the results of experimental infections of the hearts of the lower animals, can fail to have been impressed with this. In hardly any heart case, not even in the degenerative changes which are attributed to age, if there be any degenerative change in a heart due to age alone, does one fail to find the history of some infectious disease.

It would be of the greatest interest to know the medical history of those grand old men who have maintained intellectual and physical power to a great age, like Gladstone, premier of Great Britain at the age of eighty-four, for one of the early manifestations of beginning heart failure is loss of memory and difficulty to sustain mental effort. This is a point of great importance now, when hundreds of thousands of our young men are being judged as to their fitness for military duty, and when hundreds have been under observation for a disorder roughly named "'soldiers, heart." The standpoint of the deciding physician in these instances must be that of the state, not of the individual. His duty is to say whether the man examined is capable of military duty, not what remote effect military duty shall have on the heart of the man. The conclusion that in this emergency of war the state can be sure of obtaining efficient service from a man presenting some of the forms of an impaired or disordered heart, is not the same as saying that military service is good for such a man or not harmful for his future interests. If his condition promises to permit him to meet the temporary exigency, he must be passed regardless of this as of other possible dangers he may meet. This attitude warrants the assertion of Lewis in his report on the work done at Mount Vernon Hospital on "Disorders of the Heart," when he says, "The presence or absence of murmurs (wherever they may be audible) is of no value in estimating the soldier's capacity for work."

I can not agree however that evidence of a damaged valve is of no importance in prognosis. It certainly means friction, and friction means wasted energy, which in the long run must tell upon the driving power of the heart.

It is probable that what we have hitherto called "heart strain" is fundamentally made possible by some unrecognized lesion of some structure in the heart, for all persons under identical conditions do not develop acute dilatation or other disorder of the heart under great physical strain, and, on the other hand, after epidemics of mild infectious diseases, say of measles or

even of catarrhal colds, we have observed in some active boys the symptoms of slight cardiac failure and have found dilatation and murmurs.

From the standpoint of the individual, I still consider it to be our duty to acquaint our patience with the facts, emphasizing all that are favorable, but inculcating definite rules by which, without apprehension, he can know when he has overstepped the limits of his own cardiac strength, for it is the intelligent response to the information of failing strength which the heart always gives that makes a long and useful life possible to those with this handicap. In such cases, too, it seems to me a duty to attempt to direct the future career of such, and especially of children and adolescents, for there is little question that, though the heart muscle needs exercise for its development, an occupation demanding heavy and continuous work on the part of a heart that is even a little impaired must cause the earlier appearance of the evidences of beginning heart failure.

DISCUSSION.

I understood Dr. Heffron to say that he regards extra-systoles as a sign of myocardial degeneration or disease. I am convinced that you will frequently get extra-systoles or premature contractions in individuals who have no cardiac disease. There is simply an increased irritability of the heart muscle, and this is frequently seen in neurotic subjects. Some patients I have followed for a number of years have had no evidence of heart disease except the presence of extra systoles.

Persistent alternation of the pulse has grave significance. The cases that I have been able to follow have not lived more than a year after permanent pulsus alternans developed.

It used to be taught that mitral insufficiency was the easiest heart disease to recognize. As a matter of fact, it is the most difficult because systolic murmurs are so frequently heard in the absence of heart disease, and I have followed for over five years a patient who has not only a systolic murmur but an accentuated pulmonary second sound, and in that individual there has been no enlargement of the heart and no evidence of cardiac disease except this murmur, which by the way is heard only in the recumbent posture, and nobody knows how long it existed. He had been for a week in bed with a mild fever when his murmur was discovered, and the diagnosis of mitral insuffiicency and endocarditis was made at that time. A history of rheumatism or chorea is

most important in the diagnosis of mitral insufficiency of valvular origin, and in fact no matter how soft the murmur a diagnosis of valvular disease is justified if the patient has a definite history of rheumatism, and one is able to demonstrate changes in the size of the heart. For this purpose I use the orthodiagram.

I determine the vital capacity in distinguishing between cardiac neuroses and true heart disease. This test, as you may remember, was introduced by Dr. Peabody of Harvard a couple of years ago, and I have found it of great value. Neurotic patients complaining of shortness of breath on exertion will usually have a normal vital capacity, while all the cases of true heart disease that have complained of shortness of breath have had a diminished vital capacity.

Dr. R. H. Babcock: I hope the Society will not think me garrulous. I would like to speak in regard to the reference made of a systolic murmur in the pulmonary region in individuals in whom we can recognize no demonstrable enlargement of the heart. I believe from quite a number of observations during the last few years that many of these systolic basic murmurs at the left of the sternum in the second interspace are really a sign of patent ductus arteriosus. I saw last week a young man who was much disturbed because he had an attack of palpitation in January and was told by his doctor that he had a heart murmur. In this young man there was in the left third interspace close to the sternum, a circumscribed, systolic murmur and a very markedly accentuated second tone. This murmur could not be heard in the fourth interspace. There was no murmur at the apex. There was no murmur in the aortic notch at the right of the sternum. There was a very faint thrill, so faint that it could be easily overlooked by one who was not searching for a thrill. I could not trace that murmur on the first occasion upward over the apex into the scapular region as Gerhardt has described as characteristic of patent ductus arteriosus. Nevertheless I suspected that condition and sent that young man to a wellknown roentgenologist who had recognized cases of patency of the duct and called his attention to the possibility of that condition being present. He reported from fluoroscopic examination that the pulmonary artery was distinctly enlarged and pulsated with more violence than usual and he believed that the condition was a patency of the duct. When I saw the young man a day or two later and examined him with greater care I could demonstrate the Gerhardt sign was present; that is on percussion a line of impaired dullness under the clavicle at the left border of the sternum and broadening as it went downward until it reached the margin of the left auricle and that a systolic murmur could be faintly traced into the left *interscapular* region. I believe that patency of the ductus arteriosus is a much more frequent condition than is recognized. I am forced to that conclusion from the fact that I have seen in the last few years at

least three or four cases of it and have had under observation one or two cases for a number of years, and I will simply direct your attention to the fact that in discovering a systolic murmur in the second or third interspace without any demonstrable enlargement of either ventricle, we must bear in mind the patency of the duct.

I want to emphasize the importance of extra systoles. Extra systoles do not mean cardiac inadequacy particularly if these extra systoles are periodic. Many times those extra systoles are due to some toxic conditions or toxic irritation from the digestive tract or, as Lewis has said, from tobacco, tea or coffee; and it will often be found that when those systoles are not due to cardiac disease they will disappear on exercise. That is your observation, Dr. Pratt? Dr. Pratt, "Yes." And when that is the case, I think we can exclude extra systoles as meaning mild cardiac inadequacy.

Dr. W. F. R. Phillips: In regard to what Dr. Babcock said of the ductus arteriosus being patent, my attention was attracted by an article which Dr. Babcock recentiy contributed in which he spoke of the patent ductus arteriosus. I had ten cadavers on the table in which the thorax had not been opened, and I asked my students to note the condition of the ductus. In one subject we found an open ductus permitting the passage of a small probe. That would be a ratio of one to ten.

In ordinary dissecting, the ductus is taken away with connective tissue, and I had not paid any attention to it until my attention was called to it by Dr. Babcock.

Dr. Cleveland Floyd: One point as regards the other things producing lesions in the heart besides rheumatism and chorea. During the last few years we have had in Boston an epidemic of colds, and a study from the bacteriological view point shows them to be due to streptococcus and pneumococcus, and these produce a variety of lesions, and I have in my own family a girl who had a cold and an acute ear and she has a definite mitral regurgitation. No other disease has occurred, showing that we have to consider many of the mild ailments in the production of cardiac lesions than we have recently thought possible.

Dr. J. H. Elliott: On the subject of extra systoles I will say that in one of the larger Canadian Life Insurance Companies we have no occasion to reject a patient with true extra systoles, and I think Dr. Johnson spoke to us about that same subject last year. The medical board have no reason to regret their action in the matter.

Dr. I. H. Hance, Lakewood, N. J., read a paper (from manuscript) on "Rhythmical Breathing."

RHYTHMICAL BREATHING.

By IRWIN H. HANCE,

LAKEWOOD, N. J.

In a recent paper on breathing the writer called attention to the great value of deep breathing, and that the adult or child should be taught the voluntary control of the diaphragm and the internal muscles of respiration; that the volumes or currents of air may be directed through the nares over its floor or into the attic and at will the currents of air can expand the lower or the upper portions of the thorax. The use of the term "deep breathing" suggests the attainment of one end, a full great expansion of the chest, the application of which by various forms of breathing exercises will produce the result; this is undoubtedly true, but unless the proper relation in the timing of the respiratory act is also taught and mastered much energy is wasted and a lack of coördination of the breathing with muscular motion observed—hence fatigue of not alone the muscles but of the nerves as expressed by rapid heart action and breathing, the resultant being to derange the functioning power of other organs. The dynamo of life is breathing, powerful as is the dynamo when constructed perfectly how useless it would be if the timing of the interruptions of the electrical current were made in a haphazard manner; it must work rhythmically always to attain its greatest efficiency. By analogy the greatest human efficiency can be secured by rhythmical breathing, the depth of the breathing being gauged by the demands made upon the body: it must always be *rhythmical*, however. Let one walk slowly—no discord in the rhythm is apparent. Let one run then—unless trained to move rapidly irregular *rhythm* gives way to shortness of breath and inability to continue such rapid motions. The shortness of breath is nature's method of restoring proper rhythm and pre-

vents resulting injury to the lungs and heart. In other words, breathing should be timed like the dynamo to respond rhythmically to the demands made upon it; this can only be learned by practise and training. The common way is to train the various groups of muscles by setting-up exercises and let the breathing take care of itself, were we to begin the instruction with rhythmical breathing, develop the wind first, all setting-up exercise would not alone increase more rapidly muscular power but also the general efficiency of the whole man, brain, nerves and all the internal organs. Efficiency in man represents the proper functioning of all the organs and glands of the body—this is dependent upon the proper distribution of the oxygen content of the blood and the elimination of the CO_2 through the lungs, this can best be secured by proper breathing; it is not too much to say that this is generally ignored, the few are taught to breathe, the many left uninstructed—whereas nearly all seek of themselves to develop all other groups of muscles.

To breathe rhythmically one must learn absolute control of the diaphragm and the internal muscles of respiration, To learn this one must keep clearly in view the cycle of the respiratory act inspiration—pause—expiration, and concentrate the mind upon the whole action. The length of the cycle must be short at first to avoid using or straining with other external muscles. The advance from one type of breathing to the next must be gradual. For convenience the writer distinguishes three types of breathing: abdominal, diaphragmatic, and thoracic. These terms are arbitrarily used, founded partly on the physiological definitions of breathing and partly on the assumption that the power of directing at will currents of air into different sections of the lung is demonstrable. Abdominal breathing must be learned first. It gives one control of the diaphragm when mastered and makes for more rapid progress in learning diaphragmatic and thoracic.

Abdominal breathing, as its name indicates, is evidenced by the expansion of the abdominal walls—the air fills the lungs from below upwards and there is a greater distension of the lower half of the thorax than the upper.

Diaphragmatic breathing begins as in abdominal. Then by a stepping-up process the air is directed from the lower into the middle, and finally into the upper portions of the thorax; an even symmetrical expansion of the chest resulting. In this type one is prone to strain by bringing into action some of the so-called external muscles of respiration.

Thoracic breathing is evidenced by the expansion first of the upper chest and lastly the filling of the lower half, the abdominal wall protruding but slightly at its termination. Spirometer tests show that the lung capacity is greater in this than in abdominal or diaphragmatic breathing.

The position: sitting in a chair or standing adjust the body to the erect posture, spine straight, shoulders elevated without any tension on back or pectoral muscles, head so fixed that no strain of any of the neck muscles is felt, chin very slightly depressed, teeth a little apart; all body muscles are thereby in a state of relaxation. Only thus can one give undivided attention to the group of muscles which are alone to be trained and brought into action. The relaxed recumbent posture in bed enables one morning and night to test the progress made, since some persons thus grasp the idea better and appreciate more clearly the simple movement of the diaphragm than in the other postures.

Each respiratory act must be timed, inspiration and expiration being of same length, the pause or interval of rest at times somewhat shorter, it may be schematically represented as follows: while counting silently 3–2–3 about 8 seconds. The timed cycle will range in all breathing from 2–2–2 to 8–8–8. In learning abdominal breathing pay no attention to the amount of visible expansion of chest. The lower portion of the thorax alone rises and falls during these earlier efforts when the excursion of the diaphragm is so short. To begin the cycle is 3–2–3, expiration being purely passive. By concentrating the mind upon each act of respiration and avoiding all upper chest breathing one will appreciate after a few days' practise what the motion of the diaphragm, when called upon to act voluntarily, implies.

All efforts to exceed this small movement of the diaphragm in its downward and upward excursion will produce tension and strain of other muscles resulting in a visible expansion of the upper chest, this must be avoided. In drawing the air into the nose one will learn by practise how to roll the currents of air over the floor of the nose, producing thereby a nasal resonance—this sound is a proof that the nasal and throat muscles are in a state of complete relaxation. Nasal resonance of abdominal differs from the resonance produced by thoracic breathing. Three minutes devoted to these earlier efforts four or five times daily suffice, later more time is required when breathing exercises are added. Too prolonged effort produces fatigue, diminished concentration and tends to discouragement. The next step shortens the cycle to 2–2–2. By this quicker and shorter breathing one more fully appreciates that the diaphragm possesses the power, like all other muscles, of voluntarily responding to separate stimulus. By successive steps one lengthens the cycle to 3–3–3, 4–3–4, 4–4–4 and so on up to 8–8–8. When one reaches 6–6–6 it is proper to begin to learn diaphragmatic breathing.

Pumping with the diaphragm is practised in abdominal breathing and done by the quick forcible contraction of this muscles during inspiration.

Rhythm in diaphragmatic differs from abdominal breathing. To secure this rhythm one begins as in abdominal, counting two, then by a stepping-up process expands the middle and upper chest, counting two at each step, pause, counting 3—expiration of same length as inspiration counting 6, passive throughout without using abdominal muscles. (When fully carried out the result gives the best example of deep full chest breathing.) The currents of air are directed into the lower then the middle and lastly the upper portions of the lung until the chest is wholly expanded; in other words diaphragmatic breathing in a sense combines both abdominal and thoracic at the beginning and ending of the respiratory cycle. Great care must be given not

to use the external chest muscles in the middle and upper chest expansion. Rhythm of second cycle corresponds to a count of 2 as in abdominal breathing, 3 for middle, 3 for upper chest expansion—pause and expiration of same duration, namely six. In all subsequent cycles count two as in abdominal and progress to 4–4 then to 5–5.

The currents of air pass chiefly over the floor of nares as in abdominal breathing.

With the full understanding and mastery of diaphragmatic breathing one should be able, after complete full-expansion of the lungs, to perform short abdominal breathing while keeping the upper chest fully expanded.

Rhythmical thoracic breathing can now be easily understood and carried out, since it is the natural effort of everyone when asked to take a full deep breath invariably to use this type of breathing. In performing it one first notices the difference in which the air passes into and up through the attic of the nose. The louder nasal resonance produced by the other types of breathing is changed to one of a lower softer tone. One cannot produce the same volumes of nasal sound in this as in the others.

Many teachers begin their instruction in deep breathing with the thoracic type of breathing. Better results in the writer's opinion can be attained by following the method above described. Pupils make slower progress in their earlier instruction, yet when fully comprehended the power, the uses and control of the diaphragm are more readily applied.

The cycle can begin with 4–4–4 and be very quickly lengthened until 8–8–8 is counted, and it is only at the very close of a full deep thoracic breath that a slight abdominal effort is made, causing a slight protrusion of the epigastrium. For rapid quick filling of the lungs thoracic breathing accomplishes it best. Spirometer readings show that a larger volume of air is always expired after a deep thoracic breath than after the other types. Abdominal breathing records the smallest, diaphragmatic somewhat less than thoracic.

Breathing exercises should be begun when one has attained an abdominal breath cycle of 4–4–4. These must always be rhythmical, all the movements of the extremities or trunk being timed to correspond to the breath cycle. Each exercise begins with the inspiratory act. During the pause the muscles remain in their extended position, resuming the original position at the end of expiration. The pause may be shortened if desired to one half of the duration of inspiration.

Until proper rhythm is secured all exercises must be timed slowly. When later they are done rapidly the value of this method is shown by the ability of the pupil to exercise harder and longer with less fatigue and by the effect upon the heart, which often shows a lower pulse rate. When one is in perfect physical condition one can perform the same motion almost indefinitely without fatigue.

Many years ago the writer read a statement that in climbing a hill or going upstairs dyspnœa could be avoided or lessened by breathing in on advancing the right foot and breathing out when the left foot is advanced. He tried it and it worked not only with himself but especially with delicate patients. This is simply rapid rhythm of breathing. For a longer rhythm breathe in when advancing the right foot for the third step.

Besides the beneficial influence of rhythmical breathing upon the musculature and the cardio-vascular system all patients have noted that their mental powers of concentration were increased. The effect upon the neurasthenic has been to increase their powers of self control, and several have stated that in using a certain type of relaxing breath sleep could be induced in a short period of time, all of whom had previously relied upon veronal.

The effect upon these patients and upon the asthmatic has enabled the writer to dispense with the use of those drugs which we as physicians oftimes dread to administer because of the habit-forming tendency. For example, two cases of asthma where each patient used daily six to eight hypos of adrenalin

ceased using any, one in a few weeks' time and one in a few months'—other patients have been enabled to ward off the spasm of asthma by the muscular use of the diaphragm.

From personal use and the application of the above-described method and his observation upon the results secured by others during the past four years the writer has concluded that we as physicians can do much for the betterment of health as also the efficiency of individuals by directing their attention to the great need of physical training of the respiratory muscles at all ages. For the neurasthenic when inspired by your personality to faithfully learn and carry out the method you not only improve his general well being but also aid him in regaining self control by giving him light and easy daily tasks. For the asthmatic you give the power of voluntarily overcoming the tetanic spasm of the diaphragm which x-ray pictures reveal is nearly motionless. This power also enables him to abort the spasm. Having witnessed these results the writer has thought it worth while to place before you in detail a full description of the method of rhythmical breathing.

DISCUSSION.

Dr. J. H. Elliott: Dr. Hance speaks of deep breathing as a relief for asthma. Have you had any experience with the asthmatic of forty-five with rigid chest walls due to emphysema?

Dr. I. H. Hance: I can say that a man employed by the State of New Jersey who had asthma after faithfully following instructions, I seeing him once a week, told me he had ceased having his asthmatic attacks at night. He was a distinct asthmatic and also had emphysema. The results I have seen in asthma have been a surprise to me. There was a paper read by a Boston man at the A. M. A. last year, who went into the testing of foods for the cause of asthma, and he stated that all the x-ray pictures he had made showed that the diaphragm was practically immovable. I have sought to investigate that myself, and I propose to read a paper on that part of it. That is interesting to me because in studying asthma, you call it a nervous disease, but if you try to pin any physician down to what asthma is, you get a contraction of the bronchioles and you get symptoms of asthma, but it is hard for me

to get a man to clarify my mind. Now is this possible—that though you have a spasm of your bronchial tubes and that spasm of the diaphragm—is that spasm of the diaphragm the most prominent factor and is the condition of the lungs secondary to that? And that is what I am thinking over and I don't know how to prove, but when a boy who had asthma for four or five years and was so relatively cured of it that he runs and plays and he meets me on the street and commences to do this (illustrating) and then I ask you if you have voluntary control and fill your chest and then to do this (illustrating). Then I could name to you, and these names come from an instructor that taught me there are fourteen different types of breathing that this instructor makes use of. If you were lying down on a table, you can fill your chest absolutely full with that diaphragmatic type of breathing and you do not fill your chest as I am while standing up like this, and you can do the spinal breathing and if you have your hands upon the spine you can appreciate that the spine is being driven by force into your hands, and in the same way we know what costal breathing is, and I think you can see by putting my hands there that I am expanding just my ribs alone (illustrating). Now that type of breathing is different from this where I fill up my abdomen and then move up my chest (illustrating). I had a man do this (illustrating) who thought he was filling his chest. The more muscles you use of the external group, the more expenditure of force you have to make. But if you ask a patient to just make this simple motion (illustrating), go through it fifty times, I do not believe that more than five or eight of them will do it fifty times, and yet you could do it one hundred times if you did it rhythmically because you have no fatigue in contrast to doing it in a non-rhythmical manner.

Dr. R. C. Newton: Has any gentleman read a paper to the effect that angina pectoris and asthma can be arrested by walking on your hands and feet, on all fours?—when the attacks come on getting down on your hands and feet?

Dr. J. L. Heffron: From my reading it seems the tendency to explain cardiac dyspnœa and asthmatic breathing on the ground that it is due to acidosis. Whether this is an explanation, I don't know. it has any effect on the metabolism.

Dr. J. B. Hawes, 2d: Anybody who has done any rowing will realize the truth of what Dr. Hance says. The average breathing in a boat race is thirty times a minute. The breathing is invariably of the type he describes. Watch any group of oarsmen and they invariably breathe from the diaphragm down and they breathe once with every stroke. I have never given it much thought except that that is the

only time you can breathe. You breathe of course when you relax, when you are going forward; but then hold your breath going back. But it is a striking fact to anybody that has rowed to adopt this diaphragmatic type of breathing.

Dr. R. H. Babcock: This subject has been a matter that has interested me for a long time, and I have for a long time endeavored to instruct cardiac patients with regard to diaphragmatic breathing. Nearly always when I ask a patient to take a deep breath, he will draw himself in (illustrating). Now we know that that is contrary to what nature expects. The contraction of the diaphragm exerts a pumping effect on the intra-abdominal vessels and facilitates the flow of blood up into the heart, and when you do as many young men do and sink their epigastrium in inspiration they will embarrass their right heart. I have in a number of instances instructed cardiovascular patients to breathe with their diaphragms, and I remember distinctly in 1902 a boy with mitral insufficiency with an enormously congested liver which I could not reduce by anything I was able to do. I finally instructed that boy to breathe with his diaphragm and saw that the nurse had him carry that out several times a day, and to my astonishment that liver shrank to half its size with diaphragmatic breathing simply, because that boy was aspirating the blood out of the liver, and I believe that what Dr. Hance has said is of great importance, and I am impressed by what he says in asthma, but I am sceptical of its effect on some cases of asthma.

Dr. W. F. R. Phillips: I merely want to say that I think Dr. Hance has struck the physiological explanation of this whole thing. I do not exactly believe with him that it is aspiration as much as it is a propulsion of the blood. If we consider the whole anatomical situation, we will see that the abdominal veins are capable of containing all the blood in the body, that they have no muscular walls, that the only way that blood can be brought up against gravity is by the use of the diaphragm, and the other abdominal muscles, the descent of the diaphragm resisted tonically by the muscles of the external abdominal parieties, forces the blood up from the abdominal viscera into the heart. I think we might put too much emphasis on the breathing and forget what the breathing is for. It is to put the stagnant blood in motion.

Dr. R. C. Newton: I think we now see why they tell the young soldiers to "suck in their guts." That is a common instruction to soldiers.

Dr. Geo. D. Porter, Toronto, read a paper (from manuscript) on "Anti-Typhoid Inoculations in the Canadian Forces."

ANTI-TYPHOID INOCULATION IN THE CANADIAN ARMY.

By GEORGE D. PORTER, M.B., Capt. C.A.M.C.,

TORONTO, CANADA.

We have only to review the death rates from typhoid fever in recent wars to appreciate how important a factor this disease has been in modern warfare. Typhoid fever caused 8,000 deaths in the South African War, while there were only 7,700 British soldiers killed in battle. During the Spanish-American War 3,000 men died of typhoid, while there have been only 9 deaths from this disease in the army camps in the United States since September 21, 1917. In fact, the sick and death rates from this disease are so small here as to be considered negligible. This also holds true for Canada.

This wonderful improvement must in large part be attributed to compulsory inoculation against typhoid, while the improved sanitation and pure water supply materially assist in this result.

Inoculation against typhoid is compulsory in the Canadian Army and the recognition of its importance is shown by a recent order placing parades for inoculation before purely military ones. It is pointed out that "Any slight interruption in military training necessary from time to time is more than compensated for by the protection afforded by inoculation against typhoid."

While the figures given out from the front regarding the prevalence of typhoid are not readily obtainable, yet those already received are conclusive as to the great protective value of inoculation and they also prove its value in the lessened mortality amongst those who have contracted typhoid.

(In the Gallipoli Campaign the large number of cases which developed there were paratyphoid, against which there had been no inoculation. For the past two years, however, a combination of paratyphoid and typhoid vaccine has been used.)

The Research Defence Society of England issued a leaflet on the protection against typhoid afforded by inoculation, dated January, 1915, in which it reported as follows: "Among the Expeditionary Force in France and Belgium about 95 per cent. have been inoculated against typhoid fever, the annual average being about 90 per cent.

"The annual admission ratio per 1,000 is more than nine times greater among non-protected than among the protected and the death rate is thirty-one times greater among the non-protected."

An official British report states that from August, 1914, to November 10, 1915, 1, 365 cases of typhoid were reported among the British troops on France and Belgium (1,150 verified by laboratory diagnosis). In 570 cases amongst the inoculated there were 35 deaths, while in 571 cases amongst those unprotected by inoculation, there were 115 deaths. Owing to our lack of information regarding the number of inoculated soldiers who contracted typhoid, and those not inoculated who contracted the disease, it is impossible to compare the results, but these figures do show that the mortality is two thirds less among those inoculated. Another list of figures taken from the report of Dr. Jules Courtmont, of France, shows that in 1,347 cases of typhoid 891 had not been inoculated, while 225 had. Of the 891 cases uninoculated there were 155 deaths, making 17.4 per cent. Of the 256 cases inoculated there were only eight deaths, making 3.1 per cent. The mortality amongst those inoculated only once was greater than amongst those inoculated twice. and the mortality amongst those inoculated twice was greater than amongst those inoculated three times.

The technic used at the Laboratory in Military District No. 2, Toronto, is to paint a small area below the clavicle with tincture iodine, and, after boiling the needles, syringes and plungers, inject subcutaneously 1 c.c. of the anti-typhoid vaccine which equals a dose of 500,000,000 dead bacteria (250,000,000 typhoid and 250,000,000 paratyphoid). We use a 5 c.c. or 10-c.c. Record

syringe and have a number of needles, with a freshly boiled one for every inoculation. These are dropped into a basin with water heated over Bunsen flame or alcohol lamp. With an assistant painting on the iodine, we inoculate men, properly paraded, at the rate of from three to four hundred an hour, and as the men prefer to have this little ordeal over quickly they appreciate speed when properly done.

The second dose of the same strength is given from four to ten days later (usually one week), and the third dose of double the strength is given from four to ten days (usually one week) after that, making in all 2,000,000,000 dead bacteria. It is important to have the bottles containing the vaccine well shaken before using, also to have the rubber stoppers painted with iodine before inserting the needles through them for withdrawing the fluid. Our vaccine is prepared at the Ontario Provincial Laboratory.

The redness and tenderness surrounding the site of inoculation which sometimes supervenes begins to subside in a few hours. As the constitutional reaction comes on about six hours after the inoculation, consisting of malaise, headache, a slight rise of temperature and, in some cases, a tendency to faintness, light duties are advised for the men for twenty-four hours. When symptoms were severe enough the men were admitted to hospitals under the head of "inoculation fever." The usual time spent there has been from one to three days, with an occasional illness lasting five days or a week.

We have inoculated in District No. 2, between January 1, 1915, and January 1, 1917, 58, 382 men three times each, making in all 175, 146 inoculations. We have had no deaths from these and, while there have been a number of somewhat severe reactions, there have been admitted to hospital for this cause only 117 cases—less than one quarter of one per cent. of the men inoculated, or about one admission in every twelve hundred inoculations, a record which should remove any fears regarding, at least, any immediate danger from inoculation for those who

are in good health. Since that time our laboratory unit has given 16,546 additional inoculations with even better results and, where proper attention is paid to cleanliness and technique, the results should prove equally satisfactory elsewhere.

DISCUSSION.

Dr. John W. Brannan: I have not much to add if anything, but up to six months ago I have been inoculating all the nurses at Bellevue Hospital and the house staff until I got Dr. Norris to do it. I can't say what the number is, but think it is seven hundred. I found that the women bore the inoculations better than the men and practically none went to bed; whereas some of the men had a high fever after the first dose and were excused from the other dose. Some months ago in the only case in which I had trouble, in a doctor who came down with a severe attack which we thought would be fatal. Why it occurred we don't know. We have now two nurses at the hospital who came down with typhoid fever who were inoculated before they came into the hospital. Now it is required that all nurses be inoculated, and the graduate nurses have to bring a certificate to that effect. Two nurses were inoculated in the proper manner: that is, one cubic centimeter of the ordinary typhoid, giving them one million dead bacteria and then half the amount on the second inoculation.

Dr. E. O. Otis: I should like to ask the doctor how long he thinks the protection exists from the inoculation.

Dr. C. E. Edson: To answer Dr. Brannan's question: I had a group of engineers and their clerks and field men, some thirty in number, laying out an irrigation scheme in Colorado three years ago where the water was open to more than suspicion. It was in a territory in which there was a great deal of typhoid fever. They had their own camp, and the water supply was questionable, and as they went over the country the water they would get was also open to suspicion. Those thirty men were inoculated for typhoid fever and none of them came down with it though there was a great deal of typhoid in those counties that summer.

A friend of mine told me an interesting experience in any army cantonment, and I asked him about the typhoid, and he said they had only one case and he said that was a very peculiar case. The man was given his first injection and had an exceedingly violent reaction, more than anyone in the group, though some of them had been pretty severe. His case was studied, and the history was gone into carefully. The man came from Wyoming and he had exactly a

few weeks prior to the day he received his injection for typhoid prophylaxis, left home and had drunk water in a community in which there was more than an ordinary possibility of typhoid fever, and the case did develop into a true cases of typhoid fever which, however, ran a mild course after the violent reaction, and it was a case of confusion. He had the reaction just before he left home. That is a case to be reported.

Dr. Geo. D. Porter: In regard to Dr. Otis' question as to the length of time of protection: it is considered over-seas that one year is the length of time of protection, and they reinoculate every year. In Ontario they are urging the men who are working on farms. A great many are going out on farms where sporadic cases occur, and they are urging them to be reinoculated. Our laboratory was going around the districts and testing all the wells. We were told that the wells were very clear, and yet every well was found to be infected. So you see the advantage of inoculating. I feel myself that inoculations will spread to civil practice in rural districts, but in cities we have a pure water supply.

I agree with the speaker about nurses. I have never seen a nurse faint, and the reactions are not very severe. It seems to be a mental affair. I have seen soldiers faint. It is largely due to their officers. If the officer talks about inoculations, the chaps will all come up afraid and faint, but I have never seen a nurse faint and never saw a patient faint after the inoculation. It is a simple procedure. We have done many in the morning, and the whole battalion comes in, and the harm of the inoculations is exaggerated.

Regarding the latent tuberculosis: personally I wouldn't like to give an inoculation to a tuberculous patient, because I think any reaction isn't good for a tuberculous patient. I think it is the same way with tuberculin, but in the army we are not supposed to have tuberculous patients and they have to take it, and its benefits are better than the harmful effects might be otherwise. It is a simple procedure, and cleanliness and quickness are essential to make a success of it.

Dr. C. D. Parfitt, Gravehurst, Canada, read a paper (from manuscript) on "Five Years' Experience with Artificial Pneumothorax."

FIVE YEARS' EXPERIENCE WITH ARTIFICIAL PNEUMOTHORAX.

By C. D. PARFITT, M.D., C.M., and D. W. CROMBIE, M.D., C.M.,

CALYDOR SANATORIUM, GRAVENHURST, ONTARIO.

This analysis concerns 63 patients for whom induced pneumothorax was undertaken between December 18, 1912, and December 31, 1917. Information about the actual result is carried to April 30, 1918. Besides these 63 patients, a pneumothorax was produced by the replacement of pleural effusion with gas in 7 others, but as this treatment was not undertaken with the intention of maintaining compression of the lung, these cases are not included in the analysis.

The material was difficult from the standpoint of prognosis as well as from an operative standpoint. This was to be expected, since pneumothorax enters usually, with its new hope, only after other measures have already failed. A continuation of the downward course was therefore to be anticipated unless an effective compression could be obtained. In the ordinary course of events the outlook was fairly good in only 2 per cent., doubtful in 25 per cent. and bad in 73 per cent. of the series. If reasonable anticipations from pneumothorax were realized the outlook would be so improved that good, doubtful and bad would be equally divided. The patients were classified 24 per cent. moderately advanced, 76 per cent. far advanced. Only 6 per cent. were clinically unilateral (Table I). The disease had been manifest an average of 32 months, and the extreme periods were 10 years, the longest, and 3 months, the shortest. The treatment has been used with 12 per cent. of our patients since we adopted the method.

The object of the treatment was to afford relief from some distressing symptom in 48 per cent. of the patients and with

TABLE I.

N. T. A. Classification. Condition *vs.* Pneumothorax *vs.* Result.
63 Patients Treated by Artificial Pneumothorax Between December 18, 1912, and December 31, 1917.
Results Recorded to April 30, 1918.

Group.		A. C.		A.		A. A.		Q.		I.		U. I.		D.		Total.		Total.		
		I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I. and II.
Mod. Adv.	A.					1p										1p		1		1
	B.		1d		2d		1s 1d	2p			1s–i	1p		1p	1s	4p	1s–i 2s 4d	4	7	11
	C.				1d		1d						1b				1b 2d		3	3
Total			1d		3d	1p	1s 2d	2p			1s–i	1p	1b	1p	1s	5p	1b 1s–i 2s 6d	5	10	15
			1		3	1	3	2			1	1	1	1	1					

Symbols: f = No Entrance, n = Negative, b = Beneficial, b–i, s–i = At first, b, or s, Later, i, p = Pocket, i = Injurious, s = Temporary Success, d = Apparently Durable.

Note: Group I: Males, 19; Females, 9; Av. Age, ; Unilateral, 1L; Bilateral, 15R, 12L. Group II: Males, 16; Females, 19; Av. Age, ; Unilateral, 2R, 1L; Bilateral, 14R, 18L.

Complications: Tuberculous, 19 cases = 30 per cent.; Group I, 6 cases = 21 per cent.; Group II, 13 cases = 37 per cent. Non-tuberculous, 4 cases = 6 per cent.; Group I, 0; Group II, 4 cases = 11 per cent.

TABLE I.—*Continued.*

Group.		A. C.		A.		A. A.		Q.		I.		U. I.		D.		Total.		Total		
		I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I	II.	I.	II.	I.	II.	I.	II.	I. and II.
Far Adv.	A.							1p								1p		1		1
	B.								3s			3p	1b–i	2p		5p	1b–i 3s	5	4	9
	C.				1d			1p	2s 2d	2f 1p	1b 1s	4p	1n 1i 1b–i	4f 5p	5n 1i 2b 3s	6f 11p	6n 2i 1b–i 3b 6s 3d	17	21	38
Total					1d			2p	5s 2d	2f 1p	1b 1s	7p	1n 1i 2b–i	4f 7p	5n 1i 2b 3s	6f	6n 2i 2b–i 3b 9s 3d	23	25	48
					1			2	7	3	2	7	4	11	11	17p				
Total			1		4	1	3	4	7	3	3	8	5	12	12			28	35	63

these there was little anticipation of doing more. In 52 per cent. there seemed a good chance to check the progress of the disease for a longer or shorter period and in these the intention was therefore curative. Whenever a pneumothorax was indicated the attempt was usually made even though a successful compression seemed improbable because of adhesions. The x-ray was available only for little more than a year to help out the clinical selection of the cases. Had it been accessible some vain attempts would probably not have been made in the four fifths of the series undertaken without its aid.

The procedure was undertaken as an urgent measure for the control of hemorrhage in 3 patients without regard to suitability otherwise. In 95 per cent. (60) it was a matter of election and 6 of these cases were simplified by the presence of fluid, easily replaced.

The cases group themselves naturally into two classes.*

I. Compression prevented, or operative failures, those in which no gas could be introduced, or in which ineffective pockets only were produced, and

II. Satisfactory compressions, of greater or less degree, which might reasonably be expected to accomplish something. Unfortunately the statistics of artificial pneumothorax are usually

* The terms used to define the relative value of pneumothorax are significant without qualifications but further explanation may be desirable.

Operative Failure.—No entrance—no introduction of gas possible. Pocket—the formation of a pocket, quite disproportionate to the disease to be controlled, and obviously ineffective. A criticism of selection rather than a failure of treatment.

Therapeutic Failure.—Negative—course uninfluenced. Injurious—exacerbation of disease in functioning lung. The activity may not necessarily be due to the pneumothorax but to the inevitable advance of existent disease, after a temporary, even prolonged, improvement.

Palliative.—Beneficial—a distinct symptomatic improvement, *e.g.*, control of hæmoptysis, reduction of fever, control of excessive cough. Temporarily successful—a relatively high state of well-being with enlarged activities. Most will relapse, but some may become "apparently durable."

Curative.—Apparently durable—a high state of well-being and physical activity. Treatment may still be continued.

TABLE II.

N. T. A. Classification. Pneumothorax *vs.* Condition.

	Group I.		Group II.							Total.	
	Compression Prevented, 44%.		Satisfactory Compression ± Partial, 28%; Extensive, 72%. 56%.								
	Operative Failure.		Therapeutic Failure, 23%.		Palliative, 51%.		Curative.	Total.			
	No Entrance, 22%; Pocket, 78%.		Negative, 17%.	Injurious, 6%.	Beneficial, 17%.	Temporarily Successful, 34%.	Apparently Durable, 26%.				
	No.	Per Cent.	No.	No.	No.	No.	No.	No.	Per Cent.	No.	Per Cent.
Mod. Adv. A.	1	4	.....	.....	.....	.....	.....	.....	.....	1	2
Mod. Adv. B.	4	14	.....	(+1)	.....	3 (−1)	4	7	.....	11	17
Mod. Adv. C.	.....	.....	.....	.....	1	.....	2	3	.....	3	5
Total	5	18	.....	(+1)	1	3 (−1)	6	10	28	15	24
Far Adv. A.	1	4	.....	.....	.....	.....	.....	.....	.....	1	2
Far Adv. B.	5	18	.....	(+1)	1 (−1)	3	.....	4	.....	9	14
Far Adv. C.	17	60	6	2 (+1)	4 (−1)	6	3	21	.....	38	60
Total	23	82	6	2 (+2)	5 (−2)	9	3	25	72	48	76
Total	28	100	6	2 (+3)	6 (−2)	12 (−1)	9	35	100	63	100

TABLE III.

N. T. A. Classification. Pneumothorax *vs.* Result.

	Group I.		Group II.							Total.	
	Compression Prevented, 44%.		Satisfactory Compression ± Parital, 28%; Extensive, 72%. 56%.								
	Operative Failure.		Therapeutic Failure, 23%.		Palliative, 51%.		Curative.	Total.			
	No Entrance, 22%; Pocket, 78%.		Negative, 17%.	Injurious, 6%.	Beneficial, 17%.	Temporarily Successful, 34%.	Apparently Durable, 26%.				
	No.	Per Cent.	No.	No.	No.	No.	No.	No.	Per Cent.	No.	Per Cent.
A. C.							1	1	3	1	2
A.							4	4	11	4	6
A. A.	1	3				1	2	3	9	4	6
Q.	4	14				5	2	7	20	11	17
I.	3	11		(+1)	1	2 (−1)		3	9	6	10
U. I.	8	29	1	1 (+2)	3 (−2)			5	14	13	21
D.	12	43	5	1	2	4		12	34	24	38
Total	28	100	6	2 (+3)	6 (−2)	12 (−1)	9	35	100	63	100

Note.—Tables II and III: + = gain of patient from another grade. − = loss of patient to another grade.

TABLE IV.

Pneumothorax *vs.* (*a*) Bacilli Lost.

	Group I.		Group II.							Total.	
	Compression Prevented, 44%.		Satisfactory Compression ± Partial, 28%; Extensive, 72%. 56%.								
	Operative Failure.		Therapeutic Failure, 23%.		Palliative, 51%.		Curative.	Total.			
	No Entrance, 22%; Pocket, 78%.		Negative. 17%.	Injurious, 6%.	Beneficial, 17%.	Temporarily Successful, 34%.	Apparently Durable, 26%.				
	No.	Per Cent.	No.	No.	No.	No.	No.	No.	Per Cent.	No.	Per Cent.
2 had not had Bac.	1 (2?)	4	.....	.....	1 (1?)	5 (3?)	7 (2?)	13	37	14	22
(b) Working Ability.											
Able	2	7	.....	.....	.....	.....	9	9	26	11	17
Able partly	2	7	.....	.....	.....	4	.....	4	11	6	10
Unable	12	43	1	1	4	4	.....	10	29	22	35
Dead	12	43	5	1	2	4	.....	12	34	24	38
(c) Length of Life of Dead.											
Average	12 mos.		5 mos.	14 mos.	30 mos.	21 mos.	.....	15 mos.		$13\frac{1}{2}$ mos.	
Longest	50 mos.		9 mos.	.....	30 mos.	46 mos.	.....	46 mos.		.....	
Shortest	16 days.		2 mos.	.....	30 mos.	5 mos.	.....	2 mos.		.....	

burdened with the operative failures and thereby the results appear less favorable than they really are. Surely the retirement of a party of reconnaissance is not to be regarded as a defeat!

The operative failures forming group I (Tables II and III) were 44 per cent. of the total (28 cases), in 22 per cent. of which group no gas at all could be introduced.

The satisfactory compressions forming group II were 56 per cent. of the total (35 cases), and obviously extensive gas cavities were obtained in 72 per cent. of this group. It is impossible to say just how complete the compression was in most of this group because the *x*-ray was not available for the greater part of the time but it was probably complete or almost so in rather less than half the number.

The average duration of disease before treatment had been 36 months for group I and 29 months for group II. The operative failures were on the average rather more extensively diseased, 82 per cent. far advanced, than were those in whom a compression was obtained, 72 per cent. far advanced (Table II). Three of the four unilateral cases also belonged to group II. On the other hand, 21 per cent. (6 cases) in group I had tuberculous complications (2 laryngeal ulcer, 1 otitis media, 1 rectal fistula, 1 serous pleural effusion, 1 purulent pleural effusion), while 37 per cent. (13 cases) of group II had tuberculous complications (5 laryngeal tuberculosis, 2 rectal fistula, 3 intestinal tuberculosis, 4 serous pleural effusion, 1 purulent pleural effusion). Two of these 13 cases had two tuberculous complications. One of them had also severe valvular disease along with complete transplacement of the viscera, while another had a loculated pyogenic abscess, presumably interlobar. In group II also one patient had gastric ulcer and another was in the puerperium. Four cases of acute types also belonged to group II. The group of prevented compression nevertheless serves fairly as a practical control for the group of satisfactory compression.

The treatment was carried out for an average period of 7½

months for the whole series, for an average period of 18 days only for the many vain attempts on the operative failures, group I, and for an average period of 13 months for the satisfactory compressions, group II. The treatment was discontinued (optional) because completed (result accomplished) in 17 per cent. (6); maintained (optional) because desirable in 34 per cent. (12); suspended (necessity) because the object had been attained (*e.g.*, hæmoptysis controlled and continuance undesirable), or because continuance seemed to be unwise or harmful, in 37 per cent. (13); and abandoned (ineffective but previously useful) because of forming adhesions in 11 per cent. (4). Twenty of the cases (57 per cent.) passed into other hands for treatment, Each patient of the series received an average of 10 inflations but those of group I got only 4 while those in group II got 15.

The results to date have been classified after the standard formulæ of the National Association. It may perhaps be well to say that the criteria taken have not favored the treatment either by classifying doubtful cases too low when grading them, nor results too high.

It will be seen from Table III that amongst the operative failures, group I, 17 per cent. are at present quiescent or better and 43 per cent. are dead; while amongst the satisfactory compressions, group II., 43 per cent. are quiescent or better, and 34 per cent. are dead. Of the whole series 31 per cent. are quiescent or better and 38 per cent. are dead.

The average length of life after the treatment was begun was, for those who died, 13½ months for the series: 12 months for group I, and 15 months for group II (Table IV, *c*). As time elapses the difference in length of life between the two groups should increase.

Table IV, *b*, shows that 17 per cent. (11 cases) of the series are able to work and earn their own living, 7 per cent. (2 cases) in group I and 26 per cent. (9 cases) in group II; 10 per cent. (6 cases) of the series are able to work part of the day, 7 per cent. (2 cases) in group I, and 11 per cent. (4 cases) in group

II. While 27 per cent. of the series are able to earn their living entirely or in part, three-fourths of these belong to the group of successful compressions.

All but two patients of the series had had tubercle bacilli in the sputum (Table IV, *a*). These were both pleural cases, one with serous effusion along with an interlobar abscess, about which there was some doubt as to the tuberculous nature, and the other with purulent sterile fluid. Twenty-two per cent (14 cases) of the series lost bacilli, 4 per cent. (1 case) in group I and 37 per cent. in group II.

One of the operative failures, group I, in which there was very slight disease in the better lung but extreme disease on the affected side, was submitted to an extensive thoracoplastic operation at the hands of Dr. Edward Archibald, of Montreal. The first step, the removal of varying lengths of from two to four inches from the lower eight ribs, has been accomplished successfully, resulting in marked immobilisation of the side, with rapid convalescence on the part of the patient and apparent benefit. A further operation will probably be undertaken in the autumn.

Again referring to Table III, the therapeutic failures are seen to be 23 per cent. in group II; the negative results 17 per cent., the injurious 6 per cent. Only in this sense does it seem proper to us to use the word "failure" in connection with collapse therapy. The palliative results are 51 per cent. of the group; 17 per cent. were beneficial in regard to some symptoms or group of symptoms, and 34 per cent. were temporarily successful. Three cases from the palliative class later entered the injured class, one after 32 months. Six of the temporary successes are still under treatment. The curative, qualified as apparently durable, results, are 9, and form 26 per cent. of the group, one seventh of the whole series. These patients are all quiescent or better. Three of this group continue treatment. In 6 the lung has reëxpanded while in 2 of those continuing treatment the lung may not reëxpand. One of these patients was the first case treated of the series.

In the group in which pneumothorax proved to be practicable there were, therefore, but 23 per cent. of failures and 60 per cent. of temporary and apparently durable successes.

The recording of remarkable recoveries after the induction of pneumothorax has become a commonplace. A number of our cases are sufficiently dramatic to arouse keen enthusiasm for this method of treatment. The answers to a questionnaire sent to those patients who had left the sanatorium bear enthusiastic testimony of the patients' point of view about the value of pneumothorax. Indeed many of them read very much like a flamboyant patent-medicine advertisement.

Incidence of Pleural Effusion.

In the series of 63 cases there were 16 patients (25 per cent.), who had sterile, serous pleural effusion. Five of these effusions were present at the time of the initial operation, *i.e.*, in 8 per cent. of the series; and 4 of them, 11 per cent., were in group II. Eleven effusions developed during the course of the treatment; 31 per cent. of group II, or 36 per cent., excluding the original effusion.

Of the 5 original effusions, 2 were transitory, disappearing in 6 and 11 months respectively (1 moderately, 1 far advanced case) and 3 were persistent:—1 encysted (group I), 1 relieved by a thoracoplastic operation, and in 1 case the patient died from an acute type of tuberculosis.

Of the 11 effusions developing during the course of the pneumothorax 2 were transitory (2 of 3 moderately advanced cases), developing in 1 and 8 weeks respectively, and each lasting five months, while 9 were persistent, developing on an average in the fifth month. The condition of the patients in which these 11 effusions occurred were classified: Moderately advanced, B, 2, C, 1; Far advanced, B, 1, C, 7. Proportionately to the number treated in the moderately and far advanced classes (correction being made for the entire exclusion of the original effusion cases from the number considered) the incidence is not materially dif-

ferent, 37 per cent.:: 42 per cent. Two thirds of the cases developing in the moderately advanced group were transitory, and 10 per cent. were possibly transitory in the far advanced group. We are unable to say how readily an effusion may disappear after reëxpansion of the lung is permitted. These few cases of effusion, however, bear out V. Muralt's observation that the frequency of effusion varies directly with the intensity of the local disease.

All effusions were treated by aspiration except the two transitory and the one slight permanent effusion which developed during the course. Simultaneous withdrawal of fluid by syphonage and replacement by gas was the usual method employed in order not to disturb abruptly the collapsed condition of the lung. Two of the earlier effusions which developed during the course were allowed to go long periods between aspiration and lost so greatly in pneumothorax space that we have since consistently removed fluid whenever it becomes readily appreciable. We believe this to be the safer practice and the patient is at the same time more comfortable. The absence of weight upon the diaphragm, the lessened embarrassment to respiration and heart action, and the lessened dyspepsia are all points of importance to the well-being of the patient.

A strikingly successful case developed an acute, infected seropurulent effusion, following facial erysipelas, a fortnight after the patient left the sanatorium.

Two purulent tuberculous pleurisies were also treated by aspirations and replacement. Death occurred in these three cases and they are not included with the sterile serous cases, the type which forms the special complication of pneumothorax therapy.

All patients were very consistently examined both before and after refills for fluid until the advent of the x-ray, and we do not believe that cases of effusion have been missed. Possibly there was one exception (but included in the effusion group) as fluid was found in considerable amount several weeks after the patient

had left the sanatorium. Amongst the patients consistently examined by the *x*-ray (22 per cent. of the series), there has been no effusion found which could not have been detected by physical examination at a slightly later date.

Mishaps due to Operation.

During the course of the 63 cases treated, 43 so-called mishaps occurred as the result of 757 punctures and 634 refills. Excluding the 11 cases of subcutaneous emphysema as unimportant, there were 20 in group I and 11 in group II.

1. *Escape of Gas.*—(*a*) *Subcutaneous emphysema* of sufficient degree to warrant a note occurred in 11 cases of the series, 6 in group I, and 5 in group II. Occasionally it was extensive when high pressures for the separation of adhesions were used or when there was much coughing, especially if a large needle had been used. The use of a small needle invariably after the initial or second refill has lessened the escape of gas and the frequency of this incident.

(*b*) *Mediastinal emphysema* occurred 15 times in 9 patients. Thirteen (13) of these leaks took place in 8 patients of group I and 2 of them in 1 patient in group II. The symptoms of discomfort under the sternum and in the neck, slight pain beneath the sternum and in the neck on swallowing, slight swelling of the neck, and crackling on swallowing or moving the jaws, heard by the patient as well as with the stethoscope by the physician, were the significant symptoms. All symptoms usually disappeared within 36 hours. No unpleasant after effects resulted. Intrathoracic, extra-pleural emphysema, which escapes above the clavicle, and subcutaneous emphysema also might possibly be associated with a mediastinal emphysema.

After the occurrence of this incident further attempts at inducing pneumothorax have invariably been ineffective, either because of the recurrence of mediastinal emphysema or because the adherent pleural layers could not be separated. This accident arises either from the misplacing of the needle point in the

interstitial tissue of the lung; or by producing a fissure leading from the pleura to the interstitial tissue through too great pressure; or by trauma. In difficult cases the misplaced needle point may permit a moderate negative manometric reading (−3 to −5 cm. H_2O),* with a fluctuation of the water level entirely on the negative side, and with maintenance of the level when the breath is held. The flow of gas is, however, too free for the character of the initial reading, and the increased pressure, after a measured amount has been run in, slowly sinks. Moreover, the ending pressure is not materially altered when successive amounts of gas are run in. The rise in pressure is not so rapid nor so marked as is the case when pleural adhesions are present and a space is being formed by their separation. Then the dispersion of gas with falling manometer is due to the separation of the adhesions and there is a gradual rising ending pressure after successive amounts of gas are introduced.

(*c*) *Escape of gas into the peritoneal cavity* in a patient in group I at the third refill took place after 600 c.c. had been well borne at 8 cm. H_2O pressure. There was no reason to think the needle had punctured the diaphragm as the puncture had been made at the known site of the pocket and the fluctuations of the fluid levels of the manometer had been in proper relation to the respirations. Shortly afterwards the fluctuations were seen to be reversed in phase of respiration, and, after running in more gas, the patient complained of epigastric discomfort. The liver could be readily palpated by dipping. The patient suffered no harm.

(*d*) *A rupture of the pleural pocket into pulmonary tissue,* presumably through a cavity wall, occurred in 2 cases of group I. The rupture took place on the fourth and fifth attempts respectively at enlarging a pocket, under a pressure of 36 cm. H_2O in the first case. The pressure in the second case was not recorded. One of these patients died a few days later. There was no reason to think that the escape of gas played any part in hastening

* Actual not half pressures are invariably recorded.

death. This was a forlorn hope, the third case of the series, one which a maturer judgment would have declined.

2. *The puncture of a bronchus or cavity* occurred once with a former patient who had returned for investigation of the condition of the pneumothorax. Treatment had been carried on elsewhere for a year by three physicians and the patient was skeptical and concerned about her condition because of the absence of feeling, or sometimes peculiar feelings, produced by the injections of moderate quantities of gas. An air space was found immediately under the usual site of puncture, but the manometric readings were characteristic of communication with large air passages. No pleural space could be demonstrated by further punctures nor by the x-ray screen nor plates. For nine months this patient had probably been receiving injections of gas elsewhere than within the pleural space. Her eighteen months of actual compression had, however, brought about an apparently durable result.

3. *The penetration of a large vessel* occurred once in group I. A gradually rising pressure (+ 5 cm. H_2O) without fluctuation was noted in the manometer, and while watching it blood escaped into the filter tube, set in 3/16 inch tubing, about two feet from the needle. No ill result followed withdrawal of the needle.

4. *Traumatic pneumothorax from puncture of the lung* occurred four times. Two of these injuries were caused by the anæsthetic needle. In one instance the man took a rather deep breath during the infiltration of the supposed pleural layer and a slight catching sensation was felt by the operator as the lung rubbed past the needle point. A reading of − 8 −2 cm. was noted on the manometer when the special needle was introduced and the pressure rapidly rose without the introduction of gas to − 6 + 6 cm. In the other instance, a rather emotional girl, with sobbing respirations, complained of pain when the anæsthetic needle reached the neighborhood of the pleura, and she asked to sit up because of choking and dyspnœa. A Kuss needle then introduced showed a reading of − 10 + 10 cm. and the dia-

phragm phenomenon was also noted. The first of these cases, with an excellent right lung, suffered very little discomfort; the second, with considerable involvement of the left lung and with complete situs transversus along with a mitral valvular lesion, suffered much distress for some hours.

A third case resulted from an unwise manœuvre when we attempted to obtain a reading of the manometer. A pneumothorax of large volume had been induced by us nine months previously and the patient had been in other hands seven months. The man returned for examination and refill five weeks after a refill of 775 c.c. It would have been impossible to say upon which side the pneumothorax had been done except for slight apical changes in breath and voice sounds. Free gas bubbles were obtained through the anæsthetic needle. A Braun's platinum needle of rather fine calibre, connected with the manometer, but with the gas chamber shut off, was inserted 3 to 3.5 cm. through a thick chest wall. No oscillation was obtained and the patient was thoughtlessly asked to take a deep breath. A slight sucking sound was heard at the needle as if it were being cleared of obstruction and the patient felt a rattle in his left side at the same time. The water column of the manometer fell to − 4 cm. and remained there until the needle was withdrawn at the onset of symptoms. Not more than 1 c.c. of gas could have been aspirated from the tubing. Within half a minute the patient complained of numbness and tingling beginning in the left foot and extending upward throughout the side to the scalp. The sensation was limited to the left side. At the same time the patient felt slightly faint for about two minutes and became slightly pale. There was no difference in strength of hand clasp between the two hands. The legs moved easily. The tongue protrusion was straight. The left patellar and triceps reflexes were increased but were absent on the right side (possibly because of position). Ten minutes later there was an increase of both patellar reflexes. Indirect examination of both eye grounds was made at two, five and twelve minutes, and by direct examina-

tion at fifteen minutes. Nothing was detected that suggested gas embolism, but the direct examination was probably too late. After the second examination the patient complained of a slight blurring of the vision of the left eye. There was no alteration in the pupils, reflexes, movements or field of vision. Numbness soon decreased, and disappeared in half an hour. Reflexes were less active fifty minutes later. The patient then had slight dyspnœa and felt as if he had had a refill. The next day the physical signs of a pneumothorax were present. The extensor reflexes were then somewhat increased. On the third day a reading of -6.4 cm. H_2O mean pressure was obtained. The introduction of 400 c.c. gas increased this to -4 cm. mean pressure, and two days later 900 c.c. gas brought the mean pressure to 0. A somewhat similar occurrence four months later, in other hands, caused the treatment to be abandoned.

It seems rather more probable that the embolism arose from the aspiration of the air in the tubing, permitted by the yielding water column during the deep inspiration, than that it occurred from air in the lung aspirated into the vessel during subsequent respiration, or from the aspiration of air from the rapidly filling pleural space, where a negative pressure existed.

These three accidents emphasise the need of so adjusting conditions that there will be a minimum respiratory excursion when the needles are near the pleural space, especially when there is no certainty of there being a considerable volume of gas in the space. A Kuss needle for the initial operation is a great safeguard and much the easiest to use of all the needles that we have seen. This needle may now be obtained in America,* made after the French model.

Parry Morgan[2] believes that traumatic pneumothorax is of frequent occurrence during the induction of artificial pneumothorax but that it is unrecognized. These three accidents suggest that if present at all the symptoms are quite marked.

A fourth case occurred the day following the exploratory

* Messrs. Codman & Shurtleff, Boston.

puncture of a pleural space in which there had been a previous replacement of serous fluid with gas. The aspiration of reaccumulated fluid apparently filling this space was postponed until menstruation, then imminent, had passed. During the period the patient expectorated a clear "mucus" very freely. When aspiration was undertaken only gas was to be found in the space, and the plate showed the space to be apparently free from fluid. The diagnosis of the ætiological agent in this complicated case with lung abscess has never been satisfactorily determined, though not for lack of medical opinion. There was a history of similar continuous "mucous" expectoration on previous occasions long before any exploration had been made. While trauma caused by the exploratory puncture is the probable explanation, possibly in some unexplained manner spontaneous evacuation of the fluid had previously taken place and now recurred with the formation of a spontaneous pneumothorax.

5. *Gas embolism* has occurred in the one case above described along with traumatic pneumothorax.

6. *Pleural reflex* of very mild nature occurred four times in three cases, 2 of which were of group I, and 1 of group II. In the two difficult cases, apprehension and some manipulation each probably played a part. In one of these patients the same slight symptoms of faintness developed at two sittings. In the group II case the symptoms of faintness followed slight movement of the gas needle.

7. *Fainting* on slight movement following a refill occurred twice in 1 case of group II with a well established, voluminous pneumothorax. At this time the patient had a freely movable mediastinum. Less marked but similar symptoms have been noted in other patients with like flexibility of the mediastinum.

Precautions.

The need of caution regarding the amount of gas given, the slowness of the refill, and the restriction of subsequent movement, especially when the manometric readings point to a movable

mediastinum, has been dealt with in a previous paper read before this Society in 1915.[3] The maintenance of the optimum pressure for the individual is the crux of successful treatment. Too long intervals are to be deprecated, because of the reëxpansion of the lung on the one hand, and because of the inevitable intrathoracic readjustment on the other. Every endeavor should be made to maintain as uniform compression as is at all practicable. We regard bed-rest after the earlier refills as essential. The necessity of such precautions has been emphasized in our later experience.

We have, however, only recently appreciated the occasional ill-effect of 1 per cent. novocaine with adrenalin 1–10,000, in producing symptoms which we had previously attributed to altered intrathoracic conditions. Such symptoms repeated in the same patient may disappear completely with a change or omission of the local anæsthetic.

Movable Mediastinum.

The characteristics of movable mediastinum determined from the manometer were noted in 13 cases, all, of course, being in group II. The displacement of the mediastinum in every case was reasonably confirmed by physical examination. In 5 of these the inference was confirmed by the *x*-ray and in 2 of 14 cases of later date not included in the series the inference was also confirmed. In 4 patients a movable mediastinum became fixed after a number of months. The characteristics of the fixed mediastinum as determined by the manometer became marked but confirmation by x-ray examination was not possible. Two patients with marked shifting and movement of the mediastinum were shown by the x-ray to have broad, stretched adhesions above the third rib. One of these patients was referred to Dr. Edward Archibald, of Montreal, in order to have the adhesions cut, since it was thought that a better compression could then be obtained with less embarrassment to the functioning lung. It was found impossible to cut the adhesion through an

endoscope or under the fluoroscope, and the open method was resorted to. Fluttering interfered greatly at the operation and one adhesion was cut, but after the normal condition was regained a second adhesion was found, which had not been cut, to interfere with the complete collapse of the lung.

The characteristics of movable mediastinum referred to, as determined by the manometer, were first described by us in 1914[4] and elaborated in 1915,[3] and we should here like to reaffirm our belief in the accuracy of the signs and in the value of the inferences to be drawn from them. We do not see extraordinary cases of displacement because we do not displace the mediastinum unduly, either by frequently repeated small refills, or by unduly large refills. We have recently seen two cases, not our own, with obvious signs of over filling, confirmed in one instance by the *x*-ray and in the other by the manometer. In the former case the aortic arch was displaced far to the right with apparently a pneumothorax space between it and the sternum, the heart almost reaching the axillary line on expiration. The trachea could be seen on the plate far to the right, the bifurcation at the level of the first interspace slightly external to the parasternal line. A bolus of barium showed the œsophagus lying just internal to the trachea. We had no opportunity of making manometric observations in this case. In the latter case the *x*-ray was not available. The patient had received a refill of about a litre three weeks previously. The mean pressure at the time of examination was 0, and 600 c.c. of gas were removed, reducing the mean pressure to $-$ 3 cm. H_2O. Three weeks later the mean pressure was $-$ 10 cm., and after the 900 c.c. of gas were introduced a $-$ 3 cm. reading was obtained and a stationary point was noted. This pressure was then maintained, greatly to the well-being of the patient whom we lost sight of. We feel certain that over-distension could have been avoided in both cases had attention been given to the manometric indications.

A flexible mediastinum is shown by a slow rise in pressure, with relatively stationary points in the readings at some point

near the zero mark, after one or two consecutive decilitres of gas have been introduced. The amplitude of the movement of fluid in the manometer is relatively small and the movement relatively sluggish. These last two points may, however, be modified by the individual character of the breathing.

As pointed out by Hamman and Sloan,[5] a lung that remains collapsed is shown by a slow rise in pressure at first and then a sudden and marked rise.

On the contrary the fixed mediastinum shows a relatively more rapid rise in pressure, the absence of stationary points, a greater amplitude, and more abrupt movement of the fluid.

Confusing Manometric Readings.

Paradoxical movements of fluid in the manometer were seen 5 times. All were in group I cases. One was caused by escape of gas to the peritoneal cavity, described above. The other 4 could only be attributed to paradoxical movements of the diaphragm. The phenomenon of rapid rise in pressure on holding the breath at the end of inspiration, described in previous papers, was noted 13 times. Of these, 4 were in group I, and 9 in group II. The importance of this phenomenon is that it proves an exception to the rule that, when the needle is in the pleural space, the level of the fluid is maintained on holding the breath. It is therefore of practical as well as of academic interest.

The x-ray not an absolute necessity for successful treatment.

Since severe disease is sometimes extraordinarily masked because of its character or position, or because of overlying compensations, the x-ray should, whenever possible, be used to help decide whether the better lung is fit to stand the strain of pneumothorax. Marked improvements have nevertheless followed pneumothoraces when later x-ray examinations have shown that originally the inductions could scarcely have been warranted from an x-ray standpoint. The correlation of the visual and physical examinations should certainly ensure a sounder judg-

ment, but our good fortune in obtaining results well worth while, and with very little to regret, without the inhibiting influence of the x-ray upon our clinical sense, makes us realize that x-ray findings should be subjected to a generous discount when they are not backed up by reasonably correlated physical signs. In our "dark" period we undertook a number of forlorn hopes with no especial ill result, though with no benefit, and we should no doubt have more wisely refused these cases, if we had had the additional evidence from illumination. The fact that they did not do well could not be solely attributed to collapse treatment. A scale of discounts for the plate shadows in the better lung is but slowly learned, and meantime, when in doubt about the advisability of inducing pneumothorax, we are inclined to rely upon our more familiar clinical experience for the ultimate decision, even after nearly three years' intensive use of the screen and plate.

While the indication for pneumothorax is usually sufficiently clear from physical examination alone of the lung to be treated, occasionally the x-ray helps to determine the advisability of this method through revealing a masked condition previously quite unsuspected. Moreover, the evidence given by the x-ray during a period of observation may make the induction of pneumothorax quite imperative.

Forty-nine of our cases (78 per cent.) were chosen, and the early punctures made without the help of the x-ray. Screen and plate were used in six of these at later dates. Since the fiftieth case the x-ray screen and plate have been consistently used. The selection of satisfactory compressions compared with the prevented compressions was 26 per cent. better during the time without the use of the x-ray than for the time with it. Certain vain attempts may possibly be avoided when only very little descent of the diaphragm, or a much-thickened pleura, become more impressive through the aid of the screen than from the evidence of these conditions found on physical examination. But we feel strongly, because of occasional remarkable successes, that the chances against a successful induction should not deny the patient a trial when the treatment is otherwise indicated.

The screen is such a great help in following the case during and after the establishment of the pneumothorax that we should be most reluctant to be deprived of its use. In difficult cases it may help materially in choosing the best site. Judgment regarding refills is simplified, the flexibility of the mediastinum is readily estimated, slight amounts of fluid are easily detected, the exact extent and location of adhesions are defined, and the relative value of the compression can be determined. Indeed it is such an easy method of control that it is apt to discourage accurate clinical examination and note-making, and to encourage carelessness in making manometric readings and drawing possibly useful inferences therefrom. While it is a time-saver there are nevertheless compensating disadvantages.

The x-ray is of extreme value in watching the development or retrogression of disease in the functioning lung throughout the course of treatment. The uncertainty arising from transmitted adventitious sounds, and the modifications in quality of respiratory, voice and adventitious sounds because of the adjacent pneumothorax can be materially lessened by a series of stereoscopic plates. These also reveal developments often unsuspected because of compensatory changes.

We nevertheless really congratulate ourselves upon having been obliged to develop and carry on pneumothorax work for nearly four years without the facilities of the x-ray, although we often felt much handicapped without them. Careful clinical examination, a reasoned judgment, and attention to the manometer warrant the undertaking of pneumothorax therapy and it would be unfortunate to deny it only because x-ray facilities were lacking. We feel that writers on this subject when extolling the value of the screen and plate are sometimes too arbitrarily discouraging as to the practicability of the method when the x-ray cannot be used as a control.

Conclusions.

The success of artificial pneumothorax should not be depreciated by the inclusion in statistics of a large proportion of cases

in which a useful degree of compression has been prevented by physical conditions, merely because an attempt at induction has been made.

Criticism of results upon statistical evidence regarding length of life and working ability only is unfair, since the object of the treatment is to afford symptomatic relief in a large proportion of cases, as well as to effect an arrest of the disease.

The apparently durable results are five times as many for the moderately advanced as for the far advanced class.

The liability to pleural effusion in rather more than one-third of the moderately advanced cases, two thirds of the effusions being transitory, should not outweigh the advantages to be obtained from induction.

This is the most effective form of treatment that is at our disposal for the progressive case of any stage, and for indolent, moderately advanced cases. It should be applied without undue delay to those cases which conform to the requirements of selection, after a relatively brief unsuccessful application of other conventional forms of treatment.

Accidents in treatment are always imminent. Consistent carefulness is all-important.

The character of the mediastinum deserves investigation in every case and demands the adoption of pressures to meet its peculiarities.

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DISCUSSION.

Dr. Charles L. Minor: In five minutes it would be impossible to touch on the many interesting points raised in the Doctor's paper, therefore I will limit myself to four things.

First, artificial pneumothorax has behind it now so large a body

of clinical experience, and its utility has been proven in so many cases, that no man treating pulmonary tuberculosis is justified in not being thoroughly familiar with its indications and with its technic. And let me here say that a correct technic is by no means an easy thing to acquire, and that failures are often due to faulty technic.

Second, my experience has satisfied me that in early incipient cases, such as Murphy of Chicago long ago advocated pneumothorax in, the procedure is not indicated, for results are so good by our regular methods that it would be entirely unjustified to subject the patient to a proceedure which after all may possibly throw one lung permanently out of commission. I am satisfied that it should be applied to more advanced, though not necessarily far advanced cases, in which there is a spreading process which does not yield to treatment, and in which the other lung is in good enough shape to carry the burden of the work.

Thirdly, I am more and more satisfied that the Doctor is right in stating that it is much better to have shorter intervals between the re-introductions of gas. At first I followed the regular rule of working it up until there were month intervals between the re-injections, but I find that there are a certain number of cases, which, if they go longer than ten days or two weeks, will tend to have readherence between the surfaces of the pleura, and which come to failure through this, and that the only safe way is more frequent injections to prevent any such re-apposition. I have such a case at present under my care, a desperate and hopeless case apparently when she came to me, running midnight temperatures as high as a hundred and four and with a widely disseminated process all over the left lung. The results of collapse were marvelous, in reduction of temperature and in improvement of symptoms, but I unfortunately used month intervals, and before I knew it I found re-adhesion occurring which could not be stopped, the space got smaller and smaller, and finally failure was the result in a case that had promised remarkable success.

Fourth, I find that as far as I myself am concerned, I am apt to be too impatient in waiting for the local anæsthetic to take effect. Unless we give ample time for the procaine and adrenalin to take effect upon the pleura there is some pain, the patient strains and bears down, pushes his lung against the pleura, and it is impossible to get your needle into the pleural space.

Finally I would dwell upon the great wisdom of small injections of gas in the beginning, from one to three hundred cubic centimeter. When I began in 1912 I followed Brauer's advice and used as high as eighteen hundred, only to see frequent re-awakenings of trouble on the better side from the burden being thrown on that lung too quickly.

To repeat what I said in the beginning, I feel the operation, if such we call it, has come to stay, and has a very valuable place in phthisiotherapy, and that every phthisiotherapeutist must be familiar

with it. Of course the man who would apply it in every case is foolish, but its use in carefully chosen cases will give us results in a class of patients who otherwise are infallibly doomed to death.

Dr. C. H. Johnston: I do not know that I can add much to the discussion, but there are two or three points that I can touch upon. I think we must all admit the great value of the x-ray as an aid to complete diagnosis of the case and to the proper conduct of the case after we get it started. I think the x-ray is perhaps of as much value in permitting us to estimate the condition of the well lung as of the lung we are going to operate upon. I have had a number of bitter experiences in having a patient with tuberculosis under observation in whom I wanted to operate, but in whom I was deterred from operating by what the x-ray showed me to exist in the well lung. Just for illustration, a young man whom I had under observation for a year with hemorrhage: He did well, he persisted in going on the road. His weight was 175. His general condition was good, and time and time again I wanted to collapse the boy, but the x-ray showed me evidences of excessive trouble on the other side, already healed. So I sent him to a place where he could spend the winter out of doors, to a friend of mine, and he had one of his attacks of hemorrhage which he had had for a great many times. Without having taken an x-ray of the other side he died at the end of a week. I do not think there was any more indication for collapse in him.

Then another thing, Dr. Parfitt spoke of pleural effusion: I think time and time again we get a pleural effusion and we do not recognize it unless we have an x-ray and we wonder what is going on. The physical signs wont show it, but with every recurring attack of cold or reinfection in some of my patients I find a little infection in the pleural cavity. Of course, we all know the value of the x-ray in determining the condition of the lung on which we are operating.

About five years ago I saw in an English journal an article about collapsing a lung and then in a year again opening it up and then collapsing the other lung, in that way treating a bilateral case, but my experience from postmortems convinced me how utterly useless or most absurd it is to hope to do that very often. For instance one of my patients, an acute tuberculous pneumonic case, with symptoms in the upper lobe I collapsed and got a splendid recovery in six months with a chest full of fluid. He went that way for a year or two with a chest full of fluid. I could rarely get in more gas. Then he got pneumonia and died, and I had an autopsy. That diseased lung was shrunk down to a mass of gristle about as large as my two fists, and when we opened the cavity it seemed that the man had no lung at all, but after getting the fluid out we found the lung. Dr. Waterman said it was simply a mass of little cavities with fibrous tissue between, and then I thought of the article I had read of the reopening up of these

lungs. Nothing has been said about the length of time these cases have to be collapsed. In the clinic he showed me some cases that had been coming there for eight years for their gas, and he said they would have to have it all the rest of their lives. In Chicago a foreigner came in whose treatment had been done in a foreign country nine years before, showing how absurd it is to hold out to these affections the prospect of curing them in a year or two.

Dr. C. E. Edson: I am very glad to have Dr. Minor say what he did about the necessity of short intervals in refilling. I have had the same unfortunate experience in letting the patient go too long, and with a failure in a case which started out with every prospect of being most brilliant.

I want to speak also of the use of pneumothorax in cases which might be called emergency work—in cases of severe uncontrollable hemorrhage. I had a patient whose life was saved unquestionably by Captain Porter's brilliant performance of a pneumothorax. While the man was spitting blood he went in with his needle and brought out a permanent collapse and came out of it like coming out of a slaughter house, and the patient made a brilliant recovery for which the entire credit was subsequently given to christian science.

Dr. Charles L. Minor: The question is how long shall one keep up the pneumothorax treatment, and it is a question one is frequently asked. As a general proposition I do not believe it is right to go on indefinitely keeping a lung collapsed, and yet all of us feel a great anxiety when we stop gas and let the lung reëxpand, knowing that a certain number of patients will find their trouble wake up again, since it has been proven that the reëxpanded lung may relapse. It seems to me that after one or two years of compression, the legitimate thing is to try for reëxpansion. Some will be too tied down to reëxpand well, some will reëxpand perfectly. I have a young girl under my care, who was collapsed first on the right, then on the left, and whom I am now collapsing again on the right. Therefore there is no question but that lungs can reëxpand fully and come back to a normal function. However I have found that the patient who has been successfully collapsed is very apt to be afraid to have the lung reëxpanded, and wishes it kept collapsed indefinitely.

Dr. Lawrason Brown: How would you use the x-ray in determining whether or not pleurisy is present? I had a case recently which leads me to ask him this, in which from all the x-ray evidence we could get, we decided there was no pleurisy. It was not a case of tuberculosis but of abscess of the lung in which we could not separate the pleura; it was completely adherent. I think your figures of only 30 per cent. of pleurisy is much lower than we have at

Saranac. Of course, you will detect more if you use the x-ray or the the fluoroscope or the radiograph. The question of how long to collapse the lung is an interesting one. Dr. Krause who is now in Baltimore studied and found in those cases that had been collapsed fresh tubercles, which leads him to believe if you get a bad case it is better to keep it collapsed. We have had a number of unpleasant experiences, and those that give it pass some unpleasant moments. I had one case of traumatic pneumothorax in which the patient frightened me.

Another case in which we collapsed the lung died of hemothorax. There was a slight bleb which ruptured on the first instillation of gas, and the patient died.

Another case got gangrene of the lung and spat up the most foul-smelling matter. And then I had another case who insisted on having the gas at high pressure and which finally had a ruptured lung and died also. I think it is wise when speaking of pneumothorax to mention these unpleasant things.

Dr. C. D. Parfitt: Dr. Johnston mentioned the point of how long the collapse should be maintained. The time should be proportionate to the intensity of the disease. With one patient the lung was allowed to reëxpand after fifteen months and for two years there has been no reactivation of the disease.

Of the other apparently durable results the first case done who is still taking gas treatment was done five years ago. He had displacement of the viscera. His heart was way over to the left axillary line, and he kept his pneumothorax up two years and developed then in 22 months an effusion which has never given him trouble. He has passed out of my hands, but he had a pneumothorax at the time of leaving me. He had a contracted lung and very little reëxpansion and considerable negative pressure in the pneumothorax cavity. I think transudation in this part was an effort on the part of nature to make up for the negative pressure. In cases like this long-continued pneumothorax is desirable. A patient may have a pneumothorax originally which has helped him over a critical period and yet he may lose his pneumothorax later, and this gas cavity gradually contracts, but in the mean time he has been helped over a period where he would have autoinoculation on slight provocation. Dr. Dunn will remember a patient of mine who did extremely well but later lost his pneumothorax, but pneumothorax was material for that man's well being and it restored him to comparative health for a long time.

I believe entirely in small frequently repeated refills and initial small injections by aspiration, rather than by pressure. But unfortunately those cases are difficult ones, and when you wish to be careful the respiratory method of taking in gas is not very practical. I think the space for the interval of refills may be adjusted to the contraction of the lung and how readily it expands.

Dr. Brown asked a difficult question about pleura and the x-ray. I have had enough experience with the x-ray to form an opinion. My experience is to deny pneumothorax to no one in whom it is indicated and do not let adhesions prevent.

I think one has to get different criteria by the x-ray on the other lung. I believe my readings from the manometer give a great deal better results. I get detailed figures about the movement above the mediastinum. In using the x-ray and fluoroscopic plate, I think one has to discount findings in the better lung very materially and rely on clinical judgment. I am quite sure I would not have attempted it if the x-ray had been my guide. The evils proved transitory in 25 per cent. of the patients. Before getting the x-ray I used to examine patients before and after refills and put them through the procedure of succussion. An effusion isn't easily overlooked though I realize there might have been small effusions which I might have missed.

The attitude of the profession at large about this useful procedure: It was not until 1914 that the method was adopted. I should think that conservative that five to ten per cent. would be a yearly increment, and we have about 8,000 advanced cases many of whom should have pneumothorax given.

The next paper read was by F. M. Pottenger, entitled "The Significance of Limited Respiratory Movement," etc.

THE SIGNIFICANCE OF LIMITED RESPIRATORY MOVEMENT AND THE VISCERO-MOTOR, VISCERO-SENSORY AND VISCERO-TROPHIC REFLEXES, IN THE DIAGNOSIS OF PULMONARY PLEURAL INFLAMMATION.*

By F. M. POTTENGER, A.M., M.D., LL.D.,

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Careful inspection and palpation of the respiratory movements and careful observation of the motor, sensory and trophic changes in the soft structures covering the chest wall, give valuable information as to the presence or absence of inflammation, acute or chronic, affecting the pulmonary parenchyma or pleura. The value of this information is based on the fact that the nerve supply to the muscles of respiration and skin and subcutaneous tissue covering them, is in reflex connection with the sensory fibers of the sympathetic nerves which supply the lungs and pleura; and that pleural inflammation resulting in thickening and adhesions, produces degenerative changes in the contiguous soft structures (Coplin[1]) and often in the corresponding nerves as well.

There can be no inflammation of either the pulmonary tissue or the pleura without reflexly disturbing the nerve supply, the muscles of respiration and the subcutaneous tissue and skin overlying them, and without interfering with and altering the normal respiratory act. These departures from the normal respiratory act and these motor, sensory and trophic changes in the soft tissues, may be slight or very apparent; and, if carefully studied, they afford important data of diagnostic value.

* Read by title.

This subject has assumed such practical importance in my own clinical work, that I offer this study in the hope that it may help others who are striving for a better understanding of the anatomical and physiological principles underlying their causation, thus making clear their importance in the diagnosis of intrathoracic diseases.

Anatomic and Physiologic Consideration.

Aside from the lungs, the nares, pharynx, larynx, trachea, pleuræ and abdominal walls, have a part in the respiratory act.

Inspiration is distinctly and wholly a muscular act, while expiration may be partly due to elastic recoil and partly to muscular contraction. In the more recent physiologic studies, the muscle element in expiration is emphasized strongly and it becomes an active instead of a passive process (Keith).

In normal respiration, inspiration follows opening the glottis and enlarging the thoracic cavity. In forced inspiration, the alæ of the nose may be dilated. This rarely occurs in normal respiration, but is seen particularly in pneumonia. It is common in some animals.

There are many muscles which have to do with respiration. The normal inspiratory act takes place as a result of contraction of the diaphragm (the central tendon and crura being supplied by the phrenic nerves and the costal portion largely by the lower intercostals), the intercostales externi, intercartilaginei, and the levatores costarum longi et brevis.

During deep inspiration, the following accessory muscles of respiration are called into action: Scaleni, serratus posticus superior, sternocleidomastoideus, trapezius, rhomboidei, extensores columnae vertebralis, and pectoralis.

The portions of the body which are concerned in the respiratory mechanism are widely separated and take their innervation from widely different parts of the central nervous system. The action of the various mechanisms concerned in respiration,

however, is correllated in a respiratory center situated in the medulla.

Upper Air Passages.—The first parts which are affected by the inspired air, are the nasal, nasopharyngeal and laryngeal structures.

In some animals and under certain conditions in man, the alæ of the nose enlarge to aid the ingress of air. The alae of the nose and the nasal mucous membrane are supplied with vegetative fibres from both the sympathetics and the seventh cranial nerve, the latter furnishing the fibers which oppose the action of the sympathetics. These structures also receive sensory fibers from the fifth cranial nerve, which carries afferent impulses centralwards, where they are transferred to efferent fibers to complete parasympathetic reflexes. It is quite possible that reflex impulses which have a more or less wide influence upon cellular activity, arise, normally, from stimulation of the sensory nerve endings of the fifth cranial nerve during the time that the air is passing through the nares.

The evil effects of obstructed nasal respiration could then be looked upon as being due,—not to a lack of oxygenation,—but to a disturbed nerve equilibrium because of the interference with the normal sensory stimulus produced by the inrushing air, and which is probably necessary for an important reflex control of the respiratory mechanism. Favoring this theory is the fact that oxygenation does take place even if it is necessary for the child to breathe through the mouth; and regardless of this oxygenation, the child suffers serious disturbances in nerve equilibrium and in physical growth when the nares are occluded.

While this must not be considered as a settled fact, yet I offer it as a suggested explanation from the standpoint of visceral neurology.

The opening of the glottis is accomplished through the action of the laryngeal muscles.

Lower Air Passages.—As the air enters the lower air passages it distends the air cells and acting upon the filaments of the pul-

monary vagus furnishes the stimulus which causes the expiratory act.

Mechanism of Respiration.

Respiration is normally an involuntary act. It can be controlled to a certain extent, however, by the will. Extra inspirations can be taken at will for a time, so may their depth be altered; but if an excess of oxygen be added to the blood the patient feels uncomfortable and dizzy, and, unless continued effort be made, the respirations of their own accord will become less frequent and more shallow.

Inspiration under normal conditions expresses a desire on the part of the body for an additional supply of oxygen, and the depth and rate of inspiration are determined by the amount of CO_2 in the blood and its action on the respiratory center.

When more oxygen is needed, the glottis opens, the diaphragm descends and the intercostales externi and intercartilaginei contract. These latter, shortening, draw all ribs together. Inasmuch as the first rib is fairly fixed, the process results in the ribs as a whole being elevated.

The descent of the diaphragm forces the abdominal contents downward, increases the intra-abdominal pressure, pushes outward and stretches the abdominal muscles. The muscles are also stretched by the fact that the lower ribs to which they are attached are somewhat elevated by the contraction of the costal portion of the diaphragm, as shown in Figs. 1 and 3 from Eppinger.

This stretching of the abdominal muscles is followed at the end of inspiration by a definite shortening which pulls the lower costal arch downward and, acting in conjunction with the intercostales interni, which shorten at the same time, draws all the ribs downward to their resting or expiratory position.

Careful study of the respiratory act will show that the structures which make up the thoracic cage are acted upon by forces which have a tendency to increase its capacity in different directions. The chest does not enlarge in one way only, neither do the lungs expand evenly in all directions. In this connection,

one must bear in mind the difference in types of breathing between the two sexes and that assumed in different positions of the body.

We owe much to Tendeloo,[2] Haase,[3] Sibsen,[4] Keith,[5] Wenckebach[6] and Eppinger,[7] for their studies of the respiratory movements of the thoracic walls and the manner in which the pulmonary tissue expands.

In order to understand normal respiratory movements, we must consider that each lung is made up of two parts, an upper-

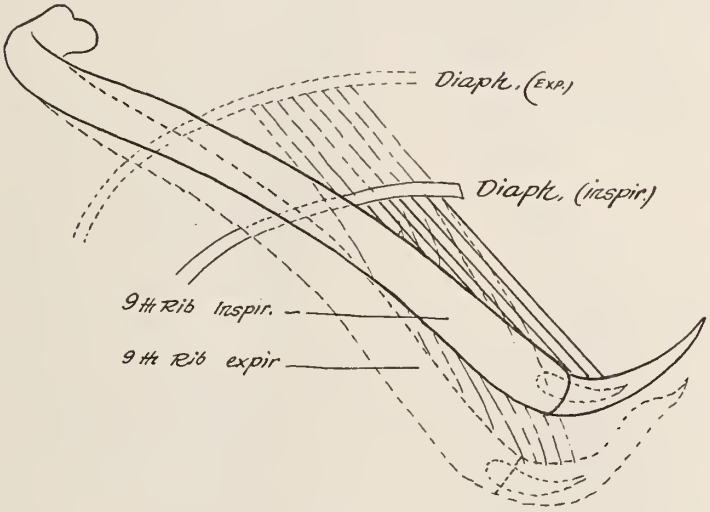

FIG. 1.

anterior, and a lower-posterior, divided by a sulcus, which, starting near the apex posteriorly, passes downward and forward. The mechanism of expansion of these two portions of the lung is different (Keith).

In order to understand the motion of the thorax during respiration, it is necessary to consider the ribs in three groups: The upper five, whose particular function it is to increase the size of the upper thorax; the sixth, seventh, eighth and ninth (and the tenth when it is joined to the sternum) as having to

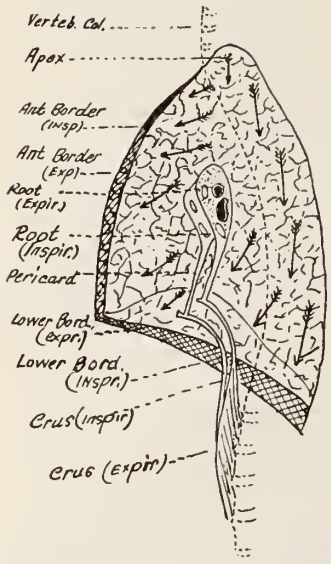

FIG. 2.

do with increasing the anteroposterior and lateral diameter of the lower portion of the thorax; and the floating ribs, the eleventh and twelfth (and in 40 per cent. of cases, the tenth) which should be considered as being a part of the abdominal wall. This latter group has no independent part in enlarging the thoracic cavity but acts with the abdominal muscles.

That portion of the lung which lies between the upper five ribs anteriorly, and the inter-lobular sulcus expands forward and upward, following the elevation and forward motion of the ribs and sternum, Figs. 2 and 3. This upper portion of the lung fits closely to the ribs—in fact, pushes out between them, so that distinct marks or furrows are to be seen on its surface. There is little or no gliding up and down between the parietal and pulmonary pleuræ, but each part is anchored more or less closely by the rib fitting into its corresponding furrow on the pulmonary surface. This explains why pleural inflammation may occur over the apices and upper part of the lung anteriorly and posteriorly without causing pain.

The lower portion of the lungs, on the other hand, from the fifth rib downward anteriorly, and particularly from the sulcus to the base posteriorly, is expanded for the most part by the contraction and descent of the diaphragm, which is accompanied by an antero-posterior and lateral enlargement of the thoracic cavity as well as the enlargement downward. The direction of the arrows in Fig. 2 shows the downward and forward expansion of this portion of the lung.

The contraction of the intercostales externi and intercartil-

aginei, together with the costal portion of the diaphragm, raises the sternum and the anterior end of the ribs.

Fig. 1 illustrates how contraction of the costal portion of the diaphragm elevates the sternal portion of the ribs. The

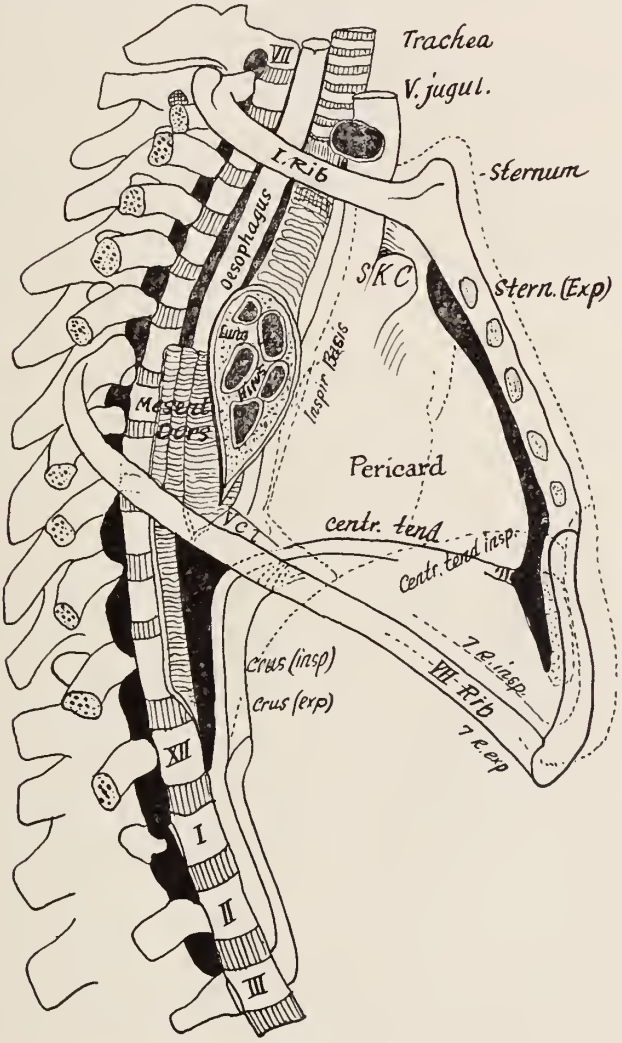

FIG. 3.

sixth, seventh, eighth, ninth and tenth ribs have a different articulation with the vertebrae from the upper five; and when these ribs are raised they also are caused to turn (like a bucket bail) on an axis connecting their sternal and vertebral articulations.

The surface of this lower portion of the lung is smooth. The ribs do not fit into furrows, and the costal and pulmonary pleural surfaces glide smoothly over each other, a considerable excursion occurring with each respiratory motion.

This is the portion of the pleura which is accompanied by severe pain when inflamed, because of its free motion and the extent of the pleural excursion. These facts show why pleurisy is best known clinically over the lower portion of the lung, while post mortems show a greater frequency of adhesions over the upper portions.

Motion of Chest Wall and Intrathoracic Inflammation.

Lagging and *diminished motion* of the chest wall have long been recognized as signs of intrathoracic disease; but the alteration in motion has not been studied with sufficient care to afford us the maximum help which can be obtained from it. They are usually spoken of as though they were one and the same thing,—in fact, it has been my habit to so consider them; but it may be that different factors enter into their production. If the two are to be distinguished, we should speak of "*lagging*" as being that condition in which a portion of the chest wall expands more slowly than the corresponding portion over the other lung (Evans)*; while the term "*diminished motion*" should be used to describe more particularly a diminution in the total amount of movement. Those portions of the thoracic cage which show lagging may, by the time that the inspiration is complete, attain an extent of motion equal to those parts where the motion began more promptly and proceeded more rapidly. This study leads me to believe that probably some distinction can be made be-

* Personal communication.

tween the two, which may be of some practical diagnostic importance. If there is distinct lagging in the beginning of and in completion of the respiratory motion in a localized area.

I am inclined to believe that it is due to either pleural adhesions and changes in the muscles which have to do with the motion of this particular portion of the bony thorax, or to a disease in the pulmonary parenchyma immediately underlying the lagging portion of the chest wall which interferes with the normal gradual distension of that portion of the lung during inspiration, while diminished motion may be due to any factor situated anywhere in either the lung or pleura, or even outside of them, which interferes directly or reflexly with the total movement of the chest wall.

There are several different factors which cause diminished motion of the thoracic walls and which should be considered carefully for their diagnostic worth. These are: (1) Diseases of the pulmonary tissue, (2) diseases of the pleura, (3) diseases of the pericardium, and (4) diseases of the sub-diaphragmatic tissues.

Diseases of the Pulmonary Tissue.—Diseases of the pulmonary tissue, cause limited motion either through: (1) Lessened elasticity of the tissue (Hofbauer and Holz Knecht[8]); (2) wasting and contraction of pulmonary tissues; or (3) reflex action (Pottenger[9]). Increased motion, on the other hand, results in that portion of the pulmonary tissue which takes upon itself compensatory emphysema in order to fill in the thoracic space which was formerly occupied by normal pulmonary tissue, and in the remaining tissue when the reserve pulmonary area has been destroyed.

1. Lessened elasticity of the pulmonary tissue results whenever areas of disease are deposited through it. To the extent that non-elastic infiltrated areas take the place of elastic lung tissue; and further, to the extent that these deposits interfere with the full distension and contraction of the remaining elastic tissue, is the motion of the lung interfered with. This has been suggested as being the sole cause of diminished motion due to

pulmonary infiltration; but by complete analysis of the inspiratory act it will be seen that it is only one factor.

2. Lessened motion due to wasting and contraction of pulmonary tissue is seen following severe destructive lesions of the pulmonary parenchyma. It is extremely common in advanced pulmonary tuberculosis, following fibrosis with contraction, or ulceration followed by fibrosis and contraction. It is also seen in the contraction following severe inflammations of the pleura, which result in the formation of large amounts of fibrous tissue which often extend into the pulmonary parenchyma.

3. It is essential to understand the nerve supply of the lung and the relationship of this nerve supply to the muscles of respiration in order to fully understand the factors which interfere with the motility of the chest wall. Every internal organ supplied by sympathetic nerves bears a reflex relationship to the skeletal muscles and other soft structures on the surface of the body. The afferent path of this reflex is through the sensory fibers of the sympathetic nervous system and the efferent path through the motor and sensory fibers of the spinal nerves.

No vegetative or involuntary fibers arise from the cervical or lower lumbar portions of the cord. These areas are devoted to supplying nerve power to the arms, and accessory muscles of respiration above and to the legs below. While no vegetative fibers arise from these areas, yet afferent impulses returning from internal viscera through the sensory fibers of the sympathetics are connected with the cells in these segments which give origin to spinal nerves and complete with them a reflex arc through which the visceral stimulus expresses itself in the superficial structures, in motor, sensory and trophic phenomena.

The lung is supplied through the stellate ganglion by sympathetic fibers which arise from the upper six dorsal segments of the cord. The afferent sympathetic fibers from the lung form a reflex arc through intercalated neurons with the spinal nerves which emerge from the cervical segments of the cord; and, when the pulmonary parenchyma is the seat of inflammation, the

spinal nerves originating in the cervical segments of the cord are stimulated and thrown into action. This action shows in changes in sensation and in increased motor action when the inflammation is acute, and in trophic disturbances if the disease becomes chronic. This pulmonary reflex seems to be distributed throughout the cervical portion of the cord, but to be most intense in the third and fourth segments. Therefore, we meet the greatest degree of alteration in sensation, the most marked muscle spasm and the greatest degree of atrophy in the skin, muscles and subcutaneous tissue which take their nerve supply from these segments.

Early in my studies of the motor reflexes which are expressed in the skeletal muscles when the pulmonary parenchyma is inflamed, I called attention to the influence which a reflex spasm of the muscles of the shoulder girdle, particularly the sternocleidomastoidei, scaleni, and the intercostales, would exert upon the motion of the upper portion of the chest wall: and, if long continued, upon the form of the bony cage (flattening it anteroposteriorly).[9, 10, 11]

Hoover in a recent paper[12] emphasizes the action of the scaleni and intercostales in limiting the undulatory movement of the upper portion of the chest wall when the underlying pleura, or pulmonary tissue in inflamed, or when a bronchus is occluded; and suggests that, while the normal motion of the second, third and fourth ribs is increasingly greater, when underlying pathological conditions are present the motion of the three is equal or approaches an equality.

While there can be no doubt that the motor reflex (spasm) which affects the accessory muscles of respiration about the shoulder girdle, particularly those which have their attachments anteriorly, exerts a continuous tension which has a limiting effect upon the motion of the chest wall; yet, it is evident that the chief source of reflex inhibition of motion arising from the *inflammation in the lung*, is found in the diaphragm, as may be inferred from Figs. 1 and 3.

To understand the full effect which interference with the action of the diaphragm exerts upon the motion of the chest wall, it is necessary to recall its innervation and study its action.

The diaphragm is the chief muscle of respiration. It consists of two portions: (1) A central tendinous portion and two strong thick muscle-masses, the crura, which attach it to the lumbar vertebræ; and (2) a costal muscular portion which makes up the peripheral portion of the organ and forms its attachments to the lower six ribs.

The central tendon of the diaphragm, from the developmental standpoint, belongs to the cervical segments of the body. Embryologically it originates immediately below the pharynx. As it descends it carries with it nerves (phrenics) from the third and fourth, sometimes the fifth, cervical segments. These supply the central portion and crura and part of the costal portion. The costal portion on the other hand, is for the most part supplied by the lower six intercostals.

From the standpoint of respiration, the spinal portion (crura), the part innervated by the phrenics, is of most importance. The central tendon lies forward of the center, nearer the sternal than the vertebral margin. The crura pass from the posterior portion of the central tendon down to their attachments to the lumbar vertebrae. During inspiration these strong muscle-masses (crura) shorten and as they do so they flatten the posterior part of the diaphragm. This forces the abdominal contents downward and forward, and at the same time increases intra-abdominal tension, which pushes the heavy, muscular, abdominal walls outward. Simultaneously, the costal portion of the diaphragm, the external intercostal and intercartilagenous muscles contract, elevating the sternum and sternal ends of the ribs. Inasmuch as the posterior ends of the ribs are fixed, this motion increases the antero-posterior diameter of the chest. Owing to the peculiar attachment of the lower ribs (sixth, seventh, eighth, ninth and in 60 per cent. of cases the tenth) at their vertebral end, as they are drawn upward and pushed

outward, they turn in such a way (like a bucket bail) as to also increase the lateral diameter of the chest. The diaphragm has little to do with the movement of the upper five ribs (although contraction of its costal portion raises the sternum with the ribs attached to it) and therefore does not exert so much influence upon the expansion of the upper lobes of the lungs as it does on the lower lobes. On the other hand, we must look upon the contraction of the spinal portion (crura) of the diaphragm as being the chief factor in the respiratory movement of the lower six ribs and in the expansion of the lower lobes.

Anything which interferes with or seriously alters the contractions of the crura of the diaphragm, interferes with the movements of the lower portion of the chest wall and with the expansion of the lower lobes of the lungs. From the nature of the case, however, it can be seen that the expansion of the entire lung is somewhat influenced.

The phrenics are given off from that portion of the cervical cord which receives most afferent impulses from the inflamed lung; consequently, when the pulmonary parenchyma is inflamed, the crura of the diaphragm are reflexly influenced. As a result of the motor reflex from the lung, the portions of the diaphragm supplied by the phrenics already show a partial contraction (spasm); and when they are called upon to further contract to carry on the inspiratory act, the total amount of shortening is less than normal; consequently, the inspiratory enlargement of the lower part of the chest wall is diminished. If the inflammation is limited to one lung, the reflex is limited to the respective crus and the diminished motion shows only on the respective side. When both sides are involved, the diminished motion is found on both sides. It must be understood, however, that the movements of the chest wall resulting wholly from the pulmonary motor reflex in early cases, are never diminished beyond the requirements for adequate oxygenation. Later they are; and deficiency in oxygenation occurs. A diminution in one part of the mechanism is compensated in another.

Diseases of the Pleura.—The pleura is supplied by nerves from both the voluntary and vegetative systems. The visceral pleura is supplied by the pulmonary plexus containing both vagus and sympathetic fibers; consequently, is brought in reflex connection with other viscera supplied by various fibers through the former, and with the skeletal tissues through the spinal nerves and the sensory filament of the latter. The parietal pleura is supplied by the intercostals, sympathetics, phrenics and vagus. The visceral pleura receives its sympathetic supply largely from the pulmonary plexuses, hence from the upper six thoracic segments of the cord; the parietal pleura on the other hand receives its sympathetic supply largely from the fibers which connect with the intercostal nerves and is brought reflexly in contact with the superficial tissues innervated by all thoracic segments. The phrenic supply to the costal pleura is confined to two small branches which are given off as the phrenic crosses the apex of the pleura. It is clear that apical pleurisy through the sensory fibers of these branches might produce diaphragmatic reflexes. The diaphragmatic pleura is supplied by both vagus and sympathetic fibers of the vegetative system and by the intercostals and phrenics of the spinal system; consequently, the diaphragmatic pleura is in reflex connection with other viscera through the vagus and with skeletal tissues through the sympathetics, intercostals and phrenics.

Unfortunately the necessity of minute study of the distribution of the sympathetic nerves to the internal viscera has heretofore been unappreciated; consequently, there are many important facts which, because of the lack of minute knowledge, cannot be asserted with positiveness. Now that we are beginning to study the viscero-motor reflexes which are associated with inflammations of internal viscera, it will be necessary for anatomists to be more specific in their description of the sympathetic nerve supply. It is not sufficient to know that the pleura is supplied by sympathetic fibers. If we wish to know where the viscero-motor reflex from the pleura expresses itself, we must

know whether these fibers are a part of the supply to the lung, or whether they are independent. This is of the greatest importance in determining the afferent paths for the visceral impulses.

From the above discussion of the innervation of the pleura, it can be seen that there are many opportunities for reflexes, sensory, motor and trophic in nature, to express themselves in the superficial tissues of the body. From the standpoint of practical diagnostics it would be interesting to follow out the sensory disturbances which result from pleural involvement but that would take us away from our subject.

The changes in movement of the chest wall which result from pleural inflammation, differ according to the location and extent of the pathological process. If it involves that portion of the pleura above the fifth rib, the corresponding intercostal muscles become rigid, contract, narrow the intercostal spaces and interfere with the free elastic motion which is normally found. If the inflammation is extensive, the motion of a large area of the upper portion of the thoracic wall on the side of the pleural inflammation may be lessened. In the remaining portion of the thorax, the motion may be markedly, slightly, or not at all lessened. We must assume in all dry pleurisies, at least, that both visceral and parietal pleuræ are involved.

If the costal pleura below the fifth rib is inflamed, the same rigidity and contraction of the corresponding intercostal muscles likewise takes place with the same narrowing of the intercostal spaces and fixing of the chest wall as mentioned above. The fixation is greater, however, because the movement of the lower ribs is normally much greater than that of the upper ribs. The normal antero-posterior and lateral enlargement of the thorax fails to ensue. The degree to which movement is interfered with depends upon the extent and severity of the inflammation.

When inflammation of the costal pleura is acute over the base, the diaphragmatic excursion may be lessened both because of the pain caused by motion and because of the motor disturb-

ance in the costal portion of the diaphragm. When acute inflammation is not present but thickening of the pleural leaves or adhesions from previous inflammation remains, the diaphragmatic excursion usually suffers some limitation.

If the costal portion of the diaphragmatic pleura is acutely inflamed, rigidity of the lower intercostal and abdominal muscles may be present with lessened movement of the chest wall. If the pleura over the central tendon of the diaphragm is inflamed, abdominal motion is lessened and as a rule reflex sensory disturbances are noted over the neck and shoulders in the third and fourth sensory cervical zones.

The fact that pain is sometimes felt in the shoulder when the pleural cavity is being filled with gas in the production of artificial pneumothorax, may be explained on the grounds: (1) That the visceral pleura is innervated by the same nerve filaments that supply the lung and that these cause a reflex in the cervical sensory zones; (2) that the diaphragm is innervated in part by the phrenics which cause a reflex in the cervical sensory zones; or (3) that the phrenics send two small twigs to the apical pleura. Stimulation of these nerve endings in any of the tissues mentioned, either by pressure or by stretching or adhesions, might produce pain in the shoulder.

Inflammation of the Pericardium.—Pericarditis is now and then accompanied by a rigidity of the upper abdominal muscles and a limitation of thoracic movement which simulates inflammation of the costal portion of the diaphragmatic pleura or of subdiaphragmatic structures.

Inflammation of Subdiaphragmatic Structures.—Subdiaphragmatic structures which cause inflammation of the peritoneum, cause a motor reflex in the abdominal muscles and a limitation of diaphragmatic excursion, resulting in lessened motion of the thoracic cage on the side of the body involved.

The difficulty of determing whether an inflammation is above or below the diaphragm, is oftentimes greater than might seem at first thought. The diaphragmatic pleura and peritoneum are

both supplied with sensory sympathetic fibers from the seventh to twelfth thoracic segments of the cord, and both cause reflexes in much the same structures.

Practical Application of Disturbances in Respiratory Movement in the Diagnosis of Intrathoracic Inflammation.

With this study of the mechanics of respiration and this discussion of the relationship between inflammation within the thoracic cage and the respiratory muscles, *it is evident that pleural and pulmonary inflammations do not express themselves in identically the same structures; and that at times the seat of the pathology may be determined by the peculiar character of the diminished respiratory motion alone.* Where this is not wholly clear from a study of the respiratory motion, it often can be accurately diagnosed when the reflex motor, sensory and trophic changes in the soft tissues have been determined by inspection and palpation. The importance of a careful study of the motion of the chest wall for its bearing upon the diagnosis of intrathoracic inflammation, should be emphasized because it not only gives important hints, but in many instances, is final in the information given.

Acute inflammation of the pulmonary tissue causes a motor reflex (spasm) which tends to lessen motion, (1) by interfering with the normal motion of the crus of the diaphragm; (2) by shortening the muscles of the shoulder girdle particularly the scaleni and sternocleidomastoideus. These influences, together with the altered elasticity will account for the diminished respiratory motion over the lung which is strictly due to the disease within the lung. They express themselves in three ways: (1) in a generally lessened motion throughout the side, (2) in a limited motion more pronounced at the base, or (3) in a limited motion more pronounced at the apex. When the diminished motion is limited largely to either the base or the apex, however, and especially if it is very marked, then an inflammation of the underlying pleura must also be suspected.

Acute inflammation of the pleura, likewise chronic inflammation which has resulted in adhesions or marked thickening, produces limited motion differing somewhat from that due to inflammation of the pulmonary parenchyma and differing according to its localization. Inasmuch as inflammation of the pleura and lung so frequently coexist in the same individual, it is not always easy to study and fully differentiate them.

Pleural inflammation affecting the upper portion of the organ, above the fifth and particularly above the third rib, is present very often accompanying an underlying tuberculous process in the lung. Its presence, however, causes a reflex motor spasm separate from that in the lung involving the corresponding intercostal muscle or muscles; and lessens the usually free inspiratory movement. The degree of limitation depends upon the acuteness and extent of the inflammation. An apical limited motion due to acute inflammation of the underlying pleura presents tense intercostals to the palpating finger. When the inflammation is chronic and thickenings have occurred; then, partly by direct extension of the inflammatory process (Coplin[1]) and partly by reflex trophic change in the overlying tissues, an increased tension is also felt, but one accompanied by a sense of decreased elasticity, the tissues feeling lifeless and doughy. The subcutaneous tissue and skin overlying also partake of the degeneration and are atrophied.

When the inflammation, either acute or chronic with thickening, affects the portion of the pleura below the fifth rib, the same conditions as far as motion and trophic reflexes are concerned exist; but the degree of limitation to motion is usually greater than when it involves the upper portion, because of the wider excursion of the pleura which normally occurs over this portion. The same tense, inelastic, doughy characteristics of tissue are noted as mentioned in connection with inflammation above the fifth rib, and can be utilized in differentiating between the involvement in the lung and in the pleura.

The fact that the intercostals are involved in the acute

motor reflex or in the degenerative process in case the lesion is chronic, narrows the intercostal spaces and prevents the normal forward and upward motion which lifts the sternum and enlarges the thorax antero-posteriorly; likewise, the rotation of the rib (bucket bail action) on the axis which corresponds to the spino-sternal articulations, which under normal conditions increases the lateral diameter of the thorax.

Acute or chronic inflammation of the diaphragmatic pleura presents different conditions according to whether the costal or the central portion is inflamed.

If the costal portion of the diaphragm is involved, the picture is much the same as that just described except the abdominal muscles are more apt to partake of the motor reflex. These are often so boardy during acute inflammation that subdiaphragmatic pathology is suspected. The motion is markedly lessened during acute inflammation; and, when the process has become chronic and adhesions have resulted, then contraction of the central tendon draws the lower ribs inward instead of forcing them outward.

When the pleura over the central tendon of the diaphragm is acutely involved, the diaphragmatic motion is limited, and the chest movements assume more of the costal type. The diminished motion resulting from inflammation of this portion of the pleura alone, however, is not of great differential value; but must be considered in connection with the two facts: (1) That the central tendon is rarely affected without some involvement of the costal portion; and (2) that characteristic sensory disturbances over the third and fourth cervical zones (Head) are nearly always present when the pleura covering the central tendon is involved.

Differentiation of the Motor and Trophic Reflexes Which Originate in the Lung From Those Originating in the Pleura.

In my early study of the motor and trophic changes in the soft tissues covering the thorax, which result from intrathoracic

inflammation, I confused those which result from the lung with those which are due to the pleura. This confusion can be now almost wholly eliminated.

The innervation of the visceral pleura, as previously shown, is the same as that of the lung. The sympathetic fibers which carry afferent impulses from the inflamed organ, would, as far as I am able to determine, take the same course, at least in part, as those from inflamed pulmonary tissue, and produce reflex action in the same cervical segments of the cord as that resulting from the lung. The sympathetic fibers of the parietal pleura, on the other hand, are given off from the vertebral ganglia and pass as non-medullated fibers, to the corresponding spinal nerves and course in the intercostal nerves. They carry afferent impulses to the corresponding thoracic segments, hence reflect in those structures which are innervated by the spinal nerves taking their origin in the same segments. *This distinction in innervation between the lung and pleura with its distinction in location of the structures which are reflexly affected, offers a basis for differentiating pulmonary from pleural inflammation.* This is of special importance to the student of tuberculosis and not without value in many other diseases.

Pulmonary Versus Pleural Motor Reflex.—The motor reflex from the lung is confined, so far as I am able to determine clinically, to those muscles which take their origin from the cervical segments of the cord, and is strongest in the third and fourth segments. It affects the diaphragm, and through it lessens the motion of the chest wall. It also manifests itself in many of the auxillary muscles of respiration, showing as increased tone (spasm). The muscles which are of particular diagnostic import are the sternocleidomastoideus, scaleni, pectoralis, trapezius, levator-anguli-scapulæ and rhomboidei. The sternocleidomastoideus and trapezius have a second reflex path through the vagus and accessorius.

Since the visceral pleura has the same sympathetic innervation as the lungs, it must cause reflexes in the same structures

when inflamed; *the parietal pleura, on the other hand, produces its reflex action in the thoracic segments and expresses itself for the most part in the intercostal muscles and the subcutaneous tissue and skin covering them.*

SEGMENTS OF CORD ORIGINATING, AND STRUCTURES SHOWING REFLEXES.

I. *Lung.*

Segments.	Motor Reflex.	Sensory Reflex.	Trophic Reflex.
C. I–C. VIII particularly C. III and C. IV.	Diaphragm C. III and C. IV (sometimes C. V). Sternocleidomastoideus, C. I–C. III, usually C. II. Scalenus ant. C. III–C. VI. " med. C. III–C. VIII. Scalenus posticus C. V–C. VIII. Pectoralis C. VI. Trapezius C. II–C. IV. Levator-ang.-scap. C. II–C. IV. Rhomboidei, major et minor C. IV and C. V.	Cervical zones C. I–C. VIII particularly C. III and C. IV.	Cervical zones C. I–C. VIII particularly C. III and C. IV.

C. = cervical.

II. *Costal Pleura and Costal Portion of Diaphragmatic Pleura.*

T. I–T. XII.	Intercostal Muscles T. II–T. XI. Serratus Posticus Sup. T. I–T. IV. Rectus Abdominus T. V–T. XII. Obliquus Abd. Ext. T. V–T. XII et internus T. VII–L. I. Transversalis Abd. T. VII–T. XII. Serratus Post inferior T. IX–T. XIII.	Thoracic zones T. I–T. XII.	Thoracic zones T. I–T. XII.

T. = thoracic; L. = lumbar.

III. *Pleura of Central Tendon of Diaphragm.*

C. III and C. IV sometimes C. IV–C. V.	Sternocleidomastoideus C. I–C. III (usually C. II). Scalenus Ant. C. III–C. VI. " Med. C. III–C. VIII. Scalenus Posticus C. V–C. VIII. Trapezius C. II–C. IV. Levator Ang. Scap. C. II–C. IV. Rhomboidei, Major et Minor C. IV and C. V.	Cervical zones C. III and C. IV sometimes C. IV and C. V.	Cervical zones C. III and C. IV sometimes C. IV and C. V.

C. = cervical.

The foregoing grouping of the segments of the cord with the structures of greater diagnostic value which are affected in the motor, sensory, and trophic reflexes, as produced by inflammations of the lung and pleura, may assist in making the matter more clear.

A glance at the above grouping of structures and zones which are in reflex relationship with the lungs and pleura, shows that they are entirely different with the exception that inflammation of the pleura over the central tendon of the diaphragm reflects in part in the same cervical segments as the lung (C. III and C. IV, or at times C. IV and C. V).

When the pleura over the central tendon of the diaphragm is inflamed, however, sensory phenomena predominate over the motor; while, when the lung is involved, motor predominate over the sensory. It is usually difficult or impossible to determine an increased muscle tone (spasm) which can positively be said to be due to the pathological lesion in the central diaphragmatic pleura because pulmonary tissue in the corresponding lung is practically always inflamed.

Table I shows the muscles of greatest diagnostic value which are affected by the motor reflex when the pulmonary tissue is involved. Table II shows the principal muscles of diagnostic worth when the pleura (excluding that portion covering the central tendon of the diaphragm) is involved.

The muscles involved in the pulmonary motor reflex belong, *with the exception of the diaphragm, to the shoulder girdle. Those involved in the pleural reflex when that portion of the pleura above the extreme base is inflamed, are aside from those involved in the pulmonary reflex, the intercostals; when the base and costal portion of the diaphragm is inflamed, the intercostals and abdominal muscles; and when the pleura covering the central tendon of the diaphragm is inflamed, the muscles from the third to fifth cervical segments as mentioned above.*

Pulmonary Versus Pleural Sensory Reflex.—Table III shows the sensory zones (cervical third and fourth) which are the seat

of the greatest amount of sensory disturbance when the pulmonary tissue is involved. The same zones are the seat of pain when the pleura over the central tendon of the diaphragm is inflamed. The pain in the latter condition is much more severe than in the former. The afferent path in the former is in the sensory fibers of the sympathetics, in the latter in the sensory fibers of the phrenics.

In Table II which shows the sensory zones (Thoracic second to eleventh) which are involved in costal pleurisy. It will be noted that they comprise the entire thoracic portion of the chest, with the exception of those areas above the second rib anteriorly and the spine of the scapula posteriorly, and the entire surface of the abdomen.

Reflex sensory disturbances caused by inflammation of the costal pleura are almost wholly confined to the surface of the chest wall unless the costal portion of the diaphragmatic pleura is involved, when the sensory changes may be and usually are transmitted along the intercostal nerves over the abdominal wall. While the sensory phenomena may be found over any portion of the abdominal wall, yet the pain is usually most severe over the diaphragmatic area itself. The extent and severity of the sensory reflex depends much upon the severity of the inflammation.

Pulmonary Versus Pleural Trophic Changes.—Nutrition is affected by both sensory and motor nerves; so, we find trophic changes in chronic inflammations in all structures which were involved in motor and sensory reflexes when the inflammation was acute. Thus the muscles which receive their innervation from the cervical portion of the cord, and particularly those from the second to fifth segments, and the skin and subcutaneous tissue innervated by these same segments, degenerate on the side of involvement when the underlying pulmonary tissue has become the seat of chronic inflammation. Likewise the intercostal muscles and the skin and subcutaneous tissue supplied by the thoracic segments of the cord which show reflex motor and sensory phenomena during acute pleural inflammation, atrophy if the inflammation becomes chronic.

A chronic inflammatory process in the lung may cause atrophy of the skin and subcutaneous tissue above the second rib and the spine of the scapula posteriorly in the cutaneous zones as supplied by the third, fourth and fifth cervical sensory nerves as shown in Figs. 4 and 5. This, as seen from the front, often appears as a *collar of degeneration* immediately below the clavicles, when both apices have been the seat of a long standing tuberculous process.

Extensive chronic hilus inflammation usually causes atrophy of the skin and subcutaneous tissue in the interscapular space. This often appears as a *saucer like* area of degeneration in the interscapular tissues, the degeneration and thinning of the subcutaneous tissue being evident to the eye, as shown in Fig. 5.

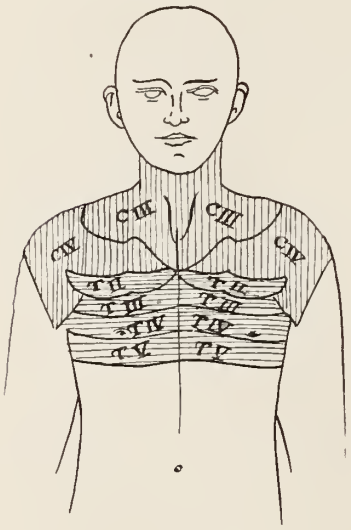

FIG. 4.

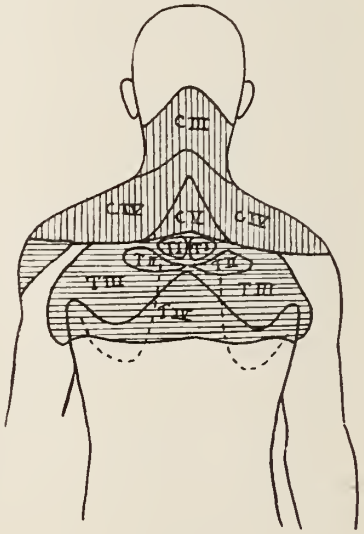

FIG. 5.

Localized atrophy of the skin and subcutaneous tissue elsewhere over the bony thorax, is due in my experience, to chronic inflammation of the underlying pleura in the path of the intercostal nerve which supplies the atrophied structures.

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Dr. Richard Cole Newton, Montclair, N. J., read a paper (from manuscript) on "A Study of Fifty Cases of Tuberculosis, mostly of the Glands and Joints, Treated with Tuberculin, compared with an Equal Number Treated without It."

FIFTY CASES OF TUBERCULOSIS, MAINLY GASEOUS AND GLANDULAR, TREATED WITH TUBERCULIN CONTRASTED WITH FIFTY CASES TREATED WITHOUT TUBERCULIN.

By RICHARD COLE NEWTON, M.D.,
and SIDNEY A. TWINCH, M.D.F.A.C.S.

Inasmuch as there seems to be at the present time a demand for facts relating to the clinical use of tuberculin in the treatment of all forms of human tuberculosis, it has seemed to us expedient and proper to give briefly, the salient points regarding our experience in this work.

Owing to the fact that the number of cases in which a course of treatment by tuberculin has been carried out is quite limited, we have been obliged to content ourselves with reporting only fifty such cases, most of which were treated in the Home for Crippled Children in Newark. As this institution has been in active operation for twenty-five years, there was no great difficulty in collecting fifty consecutive cases treated without tuberculin, and, except in a very few instances, in determining the final outcome in each case.

We have thought regarding the cases treated with tuberculin, that it would be more satisfactory to report only cases which we have personally observed and treated, than to augment our rather limited number of such cases by adding reports from the practice of others. So far as we are aware, no other orthopedic hospital except the Home for Crippled Children in Newark has used tuberculin long enough to furnish any considerable number of histories of cases treated by this method.

Its use in this institution began in 1915 and since at least between two and three years must elapse before the treatment of any considerable number of cases with tuberculin can be concluded and the results ascertained, it followed somewhat to our surprise that we could barely collect fifty completed cases from

our hospital and private practice. However, as time goes on, this difficulty is almost sure to decrease, and inasmuch as hospitals and sanatoria can furnish a great number of histories of cases of tuberculosis treated without tuberculin, the comparison of large numbers of finished cases by the two methods will become possible.

Fortunately, successful tuberculin treatment requires the greatest nicety in keeping the records of each individual case, just as it does in the administration of the remedy, so that it is reasonable to expect in a few more years such an abundance of accurate clinical histories that indisputable conclusions can be drawn from them.

Pending this increase of statistical knowledge, the data we have collected will prove of interest and will help in the world-wide fight against tuberculosis. The following tables will show as conclusively as possible, the more important facts which our study has brought to light.

Our thanks are due to Miss Milair, the superintendent of the Crippled Children's Home, and her assistants, for valuable aid in compiling these tables, and in following up cases to determine the results.

Table I summarizes the results in the treatment of fifty cases in the Home for Crippled Children without tuberculin, and Table II shows the results of treatment in an equal number of cases treated with tuberculin in the Home for Crippled Children, in the Mountainside Hospital clinic and in private practice.

We will give the conclusions which have been drawn from these tables and refer to some special cases by number.

	Per Cent.
Without tuberculin 17 recovered	34
Without tuberculin 24 died	48
Without tuberculin 9 are still wearing braces and under treatment	18
With tuberculin 33 recovered	66
With tuberculin 5 much improved	10
With tuberculin 6 died	12
With tuberculin 5 still under treatment	10
With tuberculin 1 discontinued treatment	2

TABLE I.

FIFTY CONSECUTIVE CASES OF TUBERCULOSIS TREATED WITHOUT TUBERCULIN IN THE HOME FOR CRIPPLED CHILDREN IN NEWARK, NEW JERSEY.

No.	Name.	Age.	Sex.	Nativity.	Occupation.	Diagnosis.	Date of Inception.	Period Under Treatment.	Result.
1	M. S.	7	Male.	U. S.	Minor	Potts disease.	4 yrs. of age.	11 yrs.	Died 1916.
2	L. M.	14	Female.	U. S.	"	Tub. coxitis, left.	Jan. 26, 1905.	3 yrs.	Is cured.
3	L. W.	6	Male.	U. S.	"	Dorsal Potts.	Feb., 1906.	2 yrs. 1 mo.	Died 1908.
4	M. B.	5	Female.	U. S.	"	Dorsal lumbar Potts.	1902.	6 yrs.	Died April, 1910.
5	P. G.	5	Female.	U. S.	"	Sacro-iliac Potts.	February, 1906.	2½ yrs. except 1 mo.	Died Nov. 9, 1909.
6	L. S.	11	Female.	U. S.	"	Tub. ankle, dbl.	1904.	2 yrs.	Cured.
7	T. C.	4	Male.	U. S.	"	Tub. os calcis, rt.	March, 1906.	2 yrs.	Died March 12, 1907.
8	M. F.	6	Female.	U. S.	"	Tub. coxitis, rt.	June, 1906.	8 yrs.	Cured; r. leg 1½ in. short.
9	M. H.	10	Female.	U. S.	"	Tub. ankle.	June 7, 1904.	2½ yrs.	Cured.
10	H. P.	9	Male.	U. S.	"	Tub. coxitis.	Oct., 1906.	6 mos.	Died April 5, 1907.
11	K. O.	6½	Female.	U. S.	"	Tub. coxitis, dbl.	1900.	Bet. 5 and 6 yrs.	Cured.
12	O. P.	4	Male.	U. S.	"	Tub. coxitis, rt.	Feb. 26, 1907.	2⅙ yrs.	Died May 23, 1909.
13	A. K.	5	Male.	U. S.	"	Tub. coxitis.	1904.	8 yrs.	Cured.
14	R. F.	10	Female.	U. S.	"	Tub. meningitis.	April 14, 1907.	9 days.	Died April 23, 1907.
15	E. K.	5	Male.	U. S.	"	Potts disease.	5 yrs. of age.	11 yrs.	Still wearing jacket. Age 16 yrs.
16	A. T.	7	Male.	U. S.	"	Tub. tarsus, left.	Feb., 1907. Recurrence 1916.	2 yrs.	Discharging sinus.
17	T. K.	5½	Male.	U. S.	"	Tub. coxitis, rt.	Dec. 16, 1905.	1½ yrs.	Died 1907.

TABLE I.—*Continued.*

No.	Name.	Age.	Sex.	Nativity.	Occupation.	Diagnosis.	Date of Inception.	Period Under Treatment.	Result.
18	J.McC.	3½	Male.	U. S.	Minor	Tub. knee, rt.	1907.	11 yrs.	Still wearing cast.
19	M. R.	17	Female.	U. S.	"	Tub. hip.	When small child.	1 yr.	Died 1907, age 17 yrs.
20	M. C.	3½	Female.	U. S.	"	Tub. coxitis.	April, 1907.	11 yrs.	Still has discharging sinuses.
21	J. S.	16 mos.	Male.	U. S.	"	Tub. coxitis.	June, 1908.	1 mo.	Died July 13, 1908.
22	R. G.	7	Female.	U. S.	"	Tub. coxitis.	June 11, 1908.	4 yrs.	Cured.
23	S. M.	7	Male.	U. S.	"	Potts disease.	June, 1904.	10 yrs.	Still under treatment in N. Y.
24	H. H.	6	Male.	U. S.	"	Tub. coxitis, left.	July, 1908.	5 yrs. in bad shape.	Still has discharging sinuses.
25	F. S.	17	Male.	U. S.	"	Tub. coxitis, right.	At the age of 16 yrs.	1 yr.	Died 1908, 17 yrs. of age.
26	A. W.	6	Male.	U. S.	"	Cervical Potts.	Dec. 31, 1908.	2 yrs.	Cured.
27	A. E.	6	Female.	U. S.	"	Tub. coxitis.	Feb., 1909.	3 yrs.	Cured.
28	L. P.	10	Female.	U. S.	"	Cervical tub.	Feb., 1909.	3 mos.	Died May, 1909.
29	J. R.	2	Female.	U. S.	"	Tub. knee, left.	1902.	10 yrs.	Cured.
30	B. G.	9	Female.	U. S.	"	Potts disease.	March, 1908.	3 yrs.	Died March, 1911.
31	W. B.	12½	Male.	U. S.	"	Tub. hip.	May, 1909.	2½ yrs.	Died.
32	M. C.	14	Female.	U. S.	"	Tub. hip.	May 26, 1907.	3½ yrs.	Died.
33	L. P.	6	Female.	U. S.	"	Potts.	June, 1909.	7 yrs.	Still wearing jacket.

TABLE I.—*Continued.*

No.	Name.	Age.	Sex.	Nativity.	Occupation.	Diagnosis.	Date of Inception.	Period Under Treatment.	Result.
34	P. D.	3	Male.	U. S.	Minor	Potts cervical, tub. ankle.	June, 1909.	9 yrs.	Still wearing jacket and ankle cast.
35	L. B.	3	Female.	U. S.	"	Upper dorsal Potts.	July, 1909.	3 mos.	Died Oct., 1909.
36	W. M.	18	Male.	U. S.	"	Tub. knee, right.	Aug. 31, 1909.	9 yrs.	Cured.
37	K. S.	8	Female.	U. S.	"	Tub. coxitis, rt.	Oct., 1909.	2 yrs. 7 mos.	Died May, 1911.
38	D. A.	2½	Female.	U. S.	"	Lumbar Potts.	April, 1910.	4 mos.	Died Aug. 16, 1910.
39	H. M.	15	Male.	U. S.	"	Potts disease, knee and wrist.	When a small boy.	6 yrs.	Died Oct. 29, 1911, at 16 yrs.
40	T. B.	2	Male.	U. S.	"	Potts disease, lower dorsal.	Feb., 1909.	6 yrs.	Cured.
41	M. P.	3	Male.	U. S.	"	Hip disease, rt.	Oct. 21, 1910.	6 yrs.	Cured.
42	N. B.	16	Female.	U. S.	"	Hip disease.	When a small child.	16 yrs.	Died at 21 yrs. General tub.
43	M. S.	2	Male.	U. S.	"	Potts disease, dorsal.	1911.	7 yrs. in bad shape.	Still under treatment.
44	A. S.		Female.	U. S.	"	Tub. coxitis, left.		10 yrs.	Cured.
45	T. W.	12	Male.	U. S.	"	Dbl. coxitis.	May, 1911.	1 yr. 8 mos.	Died Jan. 25, 1913.
46	C. B.	10	Male.	U. S.	"	Tub. coxitis, rt.	1911.	4 yrs.	Cured.
47	L. D.	9	Female.	U. S.	"	Sacro-iliac.	1910.	3 yrs.	Cured.
48	J. T.	3	Male.	U. S.	"	Tub. coxitis, rt.	1911.	4 yrs.	Died.
49	S. M.	3	Male.	U. S.	"	Potts disease.	Aug. 1, 1911.	1 mo.	Died Sept. 2, 1911.
50	J. D.	3	Male.	U. S.	"	Potts disease.	1910.	2 yrs.	Died Dec., 1912.

TABLE II.

FIFTY CONSECUTIVE CASES OF TUBERCULOSIS TREATED WITH TUBERCULIN IN THE HOME FOR CRIPPLED CHILDREN, NEWARK, N. J., THE MOUNTAINSIDE HOSPITAL, MONTCLAIR, N. J., AND IN PRIVATE PRACTICE.

No.	Name.	Age.	Nativity.	Sex.	Occupation.	Diagnosis.	Beginning of Treatment.	End.	Remarks and Results.
1	G. M.	10	N. Y.	F.	School.	Tub. left knee.	Nov., 1915.	Aug. 25, 1916.	Knee in plaster all summer. X-ray showed tub. March 21, 1918, perfectly well.
2	W.S.P.	29	N. Y.	M.	Clerk in store.	Pulmonary tub.	April 24, 1916.	Dec. 8, 1916.	March 21, 1918, well after 10 mos. in sanatorium.
3	E. S.	9	N. Y.	M.	.....	Tub. coxitis, l.	Aug., 1915.	.....	Treatment with plaster Dec. 13, 1909. Wore plaster spica 5 yrs. and 8 mos. Aug., 1915, Buck's extension. X-ray. Considerable contraction. Has improved. Walks about still wearing cast.
4	M. C.	4	.....	F.	.....	Tub. ankle.	Jan. 14, 1916.	.....	Perfectly well March, 1918. No reactions.
5	J.H.C.	62	U. S.	M.	Druggist.	Tub. of hilus.	June 3, 1916.	Nov. 20, 1916.	Cured.
6	F. C.	9	U. S.	M.	.....	Cervical Potts.	Dec. 28, 1915.	Sept. 28, 1916.	Under treatment since $1\frac{1}{2}$ years old. Reported perfectly well.
7	A.W.B.	$9\frac{3}{4}$	U. S.	F.	.....	Potts.	Jan., 1915.	Feb. 9, 1917.	Patient fell in March, 1911. Diagnosis made Oct. 11. Legs paralyzed for 3 yrs. Wore brace and corset. Tuberculin started. Still considerably paralyzed. Spinal operation advised.
8	Mrs. E. K.	.....	U. S.	F.	.....	Pulmonary tub., sputum pos.	April, 1917.	.....	Died after 4 mos. treatment.

TABLE II.—*Continued.*

No.	Name.	Age.	Nativity.	Sex.	Occupation.	Diagnosis.	Beginning of Treatment.	End.	Remarks and Results.
9	B. K. daughter.	3	U. S.	F.	.....	Potts.	March 2, 1917.	.....	Not doing well. May require an operation.
10	H. B.	.....	.....	M.	.....	Pleuritic tub.	Oct. 17, 1916.	May 11, 1917.	Well. Now in New York military service.
11	C. K.	$5\frac{1}{2}$	.....	M.	.....	Coxitis, l.	Nov. 26, 1915.	Jan. 2, 1917.	Died of tubercular meningitis while under tuberculin treatment.
12	D. M.	$7^{10}/_{12}$	.....	M.	.....	Coxitis, l.	Dec. 17, 1915.	April 17, 1917.	Perfectly well.
13	L. L.	.....	U. S.	M.	Refiner.	Lumbo-sacral.	Nov. 27, 1916.	Aug. 13, 1917.	Perfectly well after 15 yrs. of illness. Tuberculin treatment lasted less than 9 mos.
14	J. B.	.....	.....	M.	.....	.....	Nov. 28, 1916.	Aug. 20, 1917.	Discontinued treatment. General condition much improved.
15	K. C.	29	U. S.	F.	Housemaid.	Coxitis tub.	Nov. 24, 1915.	Feb. 13, 1917.	She has suffered from hip disease since 6 yrs. old—23 yrs. Has had several abscesses. For past 8 yrs. has been under Dr. Twinch's care. Is still wearing spica. Her general condition good. She is able to do housework.
16	J. B.	23	U. S.	M.	Moulder.	Coxitis.	Nov. 2, 1915.	Takes nuclein with tuberculin—less reaction.	10 years ago first pain in back. Albee graft. May 13. Last jacket removed Sept. 15. Under tuberculin treatment $2\frac{1}{2}$ years.
17	V. K.	32	.....	M.	Machinist.	Potts.	Oct. 23, 1915.	April 13, 1917.	No doubt of efficacy of tuberculin. Feels perfectly well. Jackets 6 or 7 years.

TABLE II.—*Continued.*

No.	Name.	Age.	Nativity.	Sex.	Occupation.	Diagnosis.	Beginning of Treatment.	End.	Remarks and Results.
18	E. W.	28	U. S.	M.	Draughtsman.	Potts.	April 8, 1916.	Nov. 19, 1917.	Died Feb. 18. Had had an Albee. Had nearly died in operation.
19	W. P.	15	U. S.	M.	School.	Hip disease.	Nov. 30, 1915.	Dec. 29, 1916.	Perfectly well, so far as known. Went through tuberculin treatment with only one reaction. Had had hip disease 7 yrs. Buck's extension, etc.
20	V.R.S.	10	U. S.	M.	School.	Hip disease, knee.	Oct. 16, 1915.	April 14, 1917.	When tuberculin was begun patient had been sick 2½ yrs. 2 months after treatment was begun, all abscesses healed and patient immensely improved. March 21, 1918, now perfectly well. All appliances and all treatment discontinued
21	H. B.	14	U. S.	F.	.....	Tub., both knees, one ankle.	March 30, 1916.	Feb. 15, 1917.	Six years of age both knees swollen and painful. Had no treatment until 8 yrs. of age. Two operations to straighten knees by other physicians. Tub. treatment begun March 3, 1916. Nov. 19, 1917, reported well.
22	F. F.	3	U. S.	F.	.....	Potts disease.	Oct. 14, 1915.	April 16, 1917.	Fell from bed at 14 mos. Lump developed on back. Treated intermittently. Tuberculin treatment begun. Is to all appearances, well. Small discharge from sinus. Still wears jacket.

TABLE II.—*Continued.*

No.	Name.	Age.	Nativity.	Sex.	Occupation.	Diagnosis.	Beginning of Treatment.	End.	Remarks and Results.
23	W. K.	5	U. S.	M.	.....	Tub. coxitis.	March 9, 1916.	Dec. 10, 1917.	Treated by private physicians, also at hospital. Tuberculin treatment begun by Dr. Twinch, March 9, 1916. Patient well, but wears brace.
24	T. T.	11	U. S.	M.	.....	Tub. coxitis, left hip.	March 9, 1916.	March 12, 1916.	Treated in hospital for six weeks. Placed in plaster cast. Finished tuberculin treatment. Reported well Sept. 6, 1917. No reaction.
25	E. T.	9	U. S.	F.	.....	Tub. knee.	Oct. 14, 1915.	Nov. 5, 1917.	Received treatment at hospital. Abscess on one knee. Tuberculin treatment started Oct. 14, 1915. Now practically well. Still wearing cast.
26	A. R.	9	U. S.	.....	.....	Tub. coxitis, left hip.	Feb. 24, 1916.	March 26, 1917.	Fell at 5 yrs. and injured one hip. Treated by osteopath. No improvement. Sent to hospital, condition improved. Buck's extension adjusted. Tuberculin treatment started Feb. 24, 1916. Finished March 26, 1917. Patient is now well. Wears no cast.
27	A. M.	6	U. S.	M.	.....	Tub. knee, left.	April 27, 1916.	May 10, 1917.	Wore a cast for 3 mos. in hospital. Went through tuberculin treatment and was reported well March 3, 1918. Wearing cast.

TABLE II.—*Continued.*

No.	Name.	Age.	Nativity.	Sex.	Occupation.	Diagnosis.	Beginning of Treatment.	End.	Remarks and Results.
28	M. J.	?	?	F.	.....	Tub. right knee joint.	Oct. 14, 1915.	July 3, 1916.	Admitted to hospital Feb. 23, 1909. Home about 6 mos. before tuberculin treatment was begun. Treatment concluded. Patient perfectly well.
29	P. Y.	?	U. S.	M.	.....	Double tub. hip.	July 17, 1916.	March 12, 1917.	Tuberculin treatment concluded. Patient reported well. Wears no brace. X-ray taken.
30	S. C.	9	N. Y.	M.	.....	Tub. right knee and ankle.	March 16, 1916.	July 30, 1917.	Patient suffered with painful knee and ankle since $2\frac{1}{2}$ years old. Treated by private physicians and in hospitals. Foot amputated. Tuberculin treatment started March 16, 1916. Bismuth injections given. Much improved. Treatment ended. Still two discharging abscesses.
31	L. V.	5	U. S.	F.	.....	Potts.	Oct. 25, 1915.	June 11, 1917.	Stopped walking at age of 3 yrs. Also lost speech and hearing. Spinal operation performed in hospital in N. Y., 1914. Tuberculin treatment begun Oct. 25, 1916. Well, as far as known.

TABLE II.—*Continued.*

No.	Name.	Age.	Nativity.	Sex.	Occupation.	Diagnosis.	Beginning of Treatment.	End.	Remarks and Results.
32	E. T.	7	U. S.	F.	.....	Cervical Potts.	March 2, 1916.	Nov. 27, 1916.	Patient lost use of both legs at age of one year. Treated in different hospitals. Under Dr. Twinch's care bed treatment given and tuberculin treatment commenced, March 2, 1916.
33	J. P.	3	U. S.	M.	.....	Tub. ankle, glands of neck and in groin.	June 29, 1916.	May 28, 1917.	Developed tuberculosis of ankle at 9 mos. Two years later glands in neck and groin affected. When admitted to home, patient had 7 sinuses on ankle discharging. Also discharging glands left groin. Tuberculin treatment and bismuth injections started. June 29, 1916. Neck glands returned to normal. All sinuses on ankle healed Nov., 1916.
34	M. H.	13	.....	F.	.....	Potts.	April 17, 1916.	Jan. 21, 1918.	Albee done 5 or 6 yrs. ago. Tuberculin treatment started April, 1916. Patient reported well. Still wearing brace.
35	C. S.	.....	.....	F.	.....	.....	April 6, 1916.	April 16, 1917.	Ailing for 6 yrs. Treated by wearing spica Dec. 24, 1913. Treatment mechanical (mainly) until tuberculin was begun. Patient doing well. Wearing no cast now.

TABLE II.—*Continued.*

No.	Name.	Age.	Nativity.	Sex.	Occupation.	Diagnosis.	Beginning of Treatment.	End.	Remarks.
36	E. McG.	.....	.....	M.	.....	Tub. ankle.	May 1, 1916.	Dec. 28, 1917.	Child can walk. Has cast on ankle. Has not reported in 5 or 6 weeks. Much improved by tuberculin treatment.
37	W. J. G.	44	U. S.	M.	Teacher.	Pul. tub., 1st stage. Sputum pos.	June 4, 1917.	May, 1918.	6 ft. $2\frac{1}{4}$ ins. Wgt. June 16, $146\frac{1}{16}$ lbs. April 18, 168. Cured. Chest expansion 4 inches. No physical signs. No bacilli. Sputum examined several times.
38	T. C.	26	Sweden.	F.	Domestic.	Tub. l. thigh and left sacro-iliac joint.	April 9, 1917.	May, 1918.	127 lbs. Cured. Has been actively at work for several months. Had been treated without efficacy, rest, corset, etc. for several months before April, 1917.
39	P. P.	$3\frac{1}{2}$	U. S.	M.	None.	Tub. of post-thoracic gld. No physical signs.	March 9, 1917.	May, 1918.	3 ft. 2 ins., March 9, 1917. 3 ft. $4\frac{1}{4}$ ins., April 25, 1917. Wgt. $30\frac{3}{4}$ lbs., March 9, 1917. Well. Grew $2\frac{1}{4}$ ins. and gained $5\frac{3}{4}$ lbs. in 2 mos., 25 days after tuberculin was begun.
40	T. P.	28	U. S.	F.	Auditor.	Latent tub. tonsillitis enlarged cervical glds.	March 9, 1917.	May, 1918.	5 ft. $6\frac{1}{4}$ ins. 118 lbs. Well.
41	C. V.	47	U. S.	F.	Housewife.	Latent tub. No signs.	June 27, 1916.	Sept. 18, 1917.	Wgt. 118 lbs., April 5, 1917. Wgt. $122\frac{1}{2}$ lbs., Jan. 5, 1918. Well.

TABLE II.—*Continued.*

No.	Name.	Age.	Nativity.	Sex.	Occupation.	Diagnosis.	Beginning of Treatment.	End.	Remarks and Results.
42	D. M.	53	U. S.	M.	Painter.	Gen. pul. tub. 2d stage. Before last illness weighed 178. Sputum always pos.	Oct. 30, 1916.	Jan. 11, 1918.	Wgt. 136¼ lbs. Gained 6¼ lbs. in 3 wks., but lost it. Died. Had been grossly intemperate and smoked 60 cigarettes a day. At first improved under tuberculin. This, however, had only a temporary effect. Condition was much improved for a considerable time by vaccines.
43	L. R.	40	U. S.	F.	Stenographer.	No pos. signs. Sputum neg. Potts disease, tuberculosis.	March 11, 1916.	Jan. 5, 1917.	Wgt. 116 lbs. 125½ lbs., Aug. 22, 1917. Well. History of tuberculosis for 26 yrs. Wore a brace 6 mos. Had three tours in Sanatoria, etc.
44	W. A.	15	U. S.	M.	Clerk.	Tubercular peritonitus.	Aug. 24, 1916.	Nov. 5, 1917.	Lost 20 lbs. in 6 wks. Under tub. gained 5 lbs. in 3 days. Perfectly well. Weighs now 146½ lbs.
45	H. Y.	27	Austria.	M.	Farm laborer.	Sputum pos. Wassermann neg. Pul. tub. both lungs.	Aug. 15, 1916.	Feb. 24, 1917.	Norm. wgt. 140 lbs. Present wgt. 103¾ lbs. Patient died. Had abdominal fistula. Operated for tubercular peritonitis in Feb., 1916. Wound did not heal. Under tuberculin weight increased to 120½ lbs. Had iritic adhesions right eye, diagnosed as syphilitic. Anti-specific treatment unavailing. Had laryngeal and general miliary tuberculosis as final stage. Had taken vaccines without much effect.

TABLE II.—*Continued.*

No.	Name.	Age.	Nativity.	Sex.	Occupation.	Diagnosis.	Beginning of Treatment.	End.	Remarks and Results.
46	R. V.	24	U. S.	F.	Student.	Tuberculosis, retro-peritoneal glands. No positive physical signs.	May 3, 1916.	June 2. 1917.	Perfectly well.
47	M. C.	17	U. S.	F.	Housework.	Pul. tub. following empyema, for which, paracentesis was done.	April 26, 1916.	Nov. 16, 1916.	Well when last seen. Very sensitive to tuberculin.
48	J. S.	30	Italy.	M.	Artisan.	Potts disease.	Feb. 16, 1917.	June 24, 1917.	Well and working every day. Had had an Albee operation.
49	L. A.	$8^{4}/_{12}$	U. S.	M.	School.	Tubercular peritonitus.	Aug. 9, 1917.	Sept. 4, 1917.	Entirely well, apparently. Was sent south. Plays with spirit. Could not play at all when treatment began. Abdomen soft and natural size instead of hard and protuberant.
50	R. D.	39	U. S.	M.	Retired.	Pul. tuberc.	Dec. 11, 1917.	Dec. 26, 1917.	This patient had suffered from pulmonary tuberculosis for 10 years. 2 years in Adirondacks, gained 27 lbs. Much better. Several months ago began to lose ground. Desired tuberculin as a dernier resort. After a few injections, had a reaction and in two or three days afterwards, a fatal hemorrhage.

Of the cases treated without tuberculin, the total period under treatment for the entire number was 235 years and 9 days; the average length of the treatment for each patient was 4 7/10 years.

Of those treated with tuberculin the total time of treatment for all the patients was 54 years, 10 mo. and 39 days, an average for each patient of 1 year, 1 mo. and 6 days.

Of the 17 cured without tuberculin the average period of treatment for each case was 5½ years.

Of the 33 cures with tuberculin, the average period of treatment for each case was 11½ months.

Of the twenty-four deaths without tuberculin the whole period of treatment was 68 years, 6 months, 9 days, or 4 years, 11 days for each patient.

Of the six deaths of those treated with tuberculin the total period of treatment was 3 years, 19 months and 53 days, or an average of 9 months, 7 days for each patient.

Of those treated without tuberculin, nine are still under treatment.

Of those treated with tuberculin, five are still under treatment.

Unfortunately, we have no records of the weight of the patients treated without tuberculin, and in only a few of those treated with tuberculin, was the weight properly observed of these, a few seem worthy of notice. We see from Table II that no. 37 gained ten pounds in a month and two days after tuberculin was begun and has gained 21½ lbs. in all.

No. 42 gained 6¼ lbs. in three weeks after tuberculin treatment was instituted, although he finally succumbed to advanced Tuberculosis and the mixed infection which accompanies it.

No. 43 gained 12½ lbs. under treatment. He recovered.

No. 39 a little boy 3½ years old, gained in ten weeks after treatment was begun, 5¾ lbs. He recovered.

No. 45 gained in three months 17¼ lbs., although he died when he had been under treatment six months and one week.

No. 44 gained five lbs. in five days after treatment was begun.

While in some cases which were not emaciated at the beginning of treatment, there was little, or no increase of weight, still the six cases quoted seemed to show that tuberculin even in cases where it finally loses its remedial efficiency, is a powerful tonic at least, when first administered.

It will be observed that, of the fatal cases in Table II, four were advanced cases of pulmonary tuberculosis when tuberculin treatment was begun. Of these, three improved temporarily under this treatment, and two of them probably owed several months more of life to tuberculin. Although most writers on tubercular therapy do not advise giving tuberculin, even experimentally, to such patients.

The references to be drawn from the figures setting forth the length of treatment and the results of treatment in the two classes are too obvious to require extended comment.

The great interest which inheres in this study will, no doubt, lead others to follow similar lines of investigation and leads us to promise that as our material and experience increase, we shall be glad to pursue this fascinating study as far as we have the time and the ability.

The truth is mighty and will prevail, and it is not unreasonable to predict that the misconception and prejudice which have confused the rationale of tuberculin treatment in the minds of many of our professional brethren, will be cleared away by a sufficient number of accurate and carefully recorded clinical histories of patients treated by this method.

Dr. R. C. Paterson, Saranac Lake, N. Y., read a paper (from manuscript) on "Granular Tuberculous Conjunctivitis Treated by Instillations of Tuberculin."

GRANULAR TUBERCULOUS CONJUNCTIVITIS TREATED BY INSTILLATIONS OF TUBERCULIN.*

By ROBERT C. PATERSON, M.D.,

SARANAC LAKE, N. Y.

The following case is reported to call attention to a method of treating a subacute tuberculous condition of the conjunctiva which, so far as I know, has not been previously employed except by Ellis and Gay,† whose article came to my notice after treatment had been inaugurated. This case also demonstrates the beneficial effects of controllable focal reactions produced by tuberculin on tuberculous tissues.

Case History. C. S., male, clerk in a shipping office, aged twenty-three years. Has had symptoms of pulmonary tuberculosis since the early summer of 1916. Examination of the chest shows a marked infiltration of the right upper and middle lobes and to a lesser extent in the lower part of the left upper lobe. Tubercle bacilli were present in the sputum. There is some involvement of the larynx, with marked hoarseness, for the past eighteen months. Although he has had hemoptysis on several occasions, the course of the disease has been one of slow improvement. In May, 1917, the patient first noticed that the left eye was inflamed, and pain, which was severe enough to keep him awake at nights, was felt in the eye and forehead. Reading increased the pain; there was little discharge and the lids were never glued together in the morning; there was no photophobia; vision was said to be somewhat blurred; there was no fever associated with this condition. I first saw the patient early in August, 1917, at which time the inner part of the left bulbar

* Read before the American Climatological and Clinical Association June 5, 1918.

† *Lancet*, August 4, 1917, No. 4901, cxciii, 156.

conjunctiva and the part below the cornea were covered with pale, sluggish, trachoma-like granulations, which were also present on the conjunctival surfaces of both eyelids, especially the lower. There was some injection of the conjunctival vessels; no ulceration was present and there were no definite tubercles. The cornea was not involved. There was no enlargement of the preauricular lymph nodes. A small amount of mucoid secretion was present, but this was not marked. Cultures from the conjunctival sac revealed staphylococci and a large Gram-positive bacillus. The condition failed to respond to the ordinary eye washes and astringents. With the approval of Dr. E. R. Baldwin, who agreed that the condition was probably tuberculous, on August 17, 2 drops of a 0.00001 dilution of O.T. were instilled directly into the left conjunctival sac. No reaction followed this, and on August 21, 2 drops of 0.0001 O.T. were instilled likewise without reaction. On August 24, 2 drops of 0.001 O.T. were instilled and 2 drops of this same solution were again introduced four days later, no reaction following in either case. On September 6, 2 drops of 1 per cent. solution of O.T. were instilled into the left conjunctival sac, and this was followed by a sharp local reaction, characterized by increase in the pain during the evening of the day on which the instillation was made, by marked increase in the amount of secretion, which became thick and yellowish, causing the eyelids to stick together. There was marked dilatation of all the conjunctival vessels and swelling of the conjunctiva and lids. This reaction passed off within forty-eight hours, by the end of which time the conjunctiva appeared clearer and the granulations were smaller than before the treatment. Ten days later a similar dose, namely, 2 drops of 1 per cent. solution, was instilled and almost immediately a dilatation of the conjunctival vessels could be seen and a sharp reaction followed, as in the former instance. This treatment was continued for six doses, at about ten-day intervals, making in all eight treatments, with reactions, after which the conjunctiva showed little evidence of disease. All symptoms had

entirely disappeared, and at the time of writing the only evidence of previous disease is a few fine granulations and slight reddening of the bulbar conjunctiva at the extreme inner canthus. The palpebral conjunctiva is clear, but there seems to be some thickening, as the palpebral slit is slightly narrower than that of the opposite eye and the patient is not able to open the affected eye quite as widely as the right. The lung condition and throat disease have been quiescent during the treatment and have not been affected by the reactions. The patient is now doing light office work for the first time in two years.

Discussion.—Tuberculosis of the conjunctiva is one of the rarer localizations of this infection and may occur in the form of (1) ulcers, including lupus; (2) miliary tubercles; (3) granulations, including phlyctenules; (4) pedunculated tumors. A full description of these various forms and a general discussion of the subject of tuberculosis of the conjunctiva has been given by Eyres* in the Hunterian Lecture of 1912. Although tubercle bacilli were not demonstrated and no histological study was made of the granulations, as I did not care to excise any of the tissue for fear an ulcer would result at the site of the wound if bacilli were present in the granulations, the case here reported is in all probability one of tuberculosis of the conjunctiva. The clinical features in this case closely resembled the picture seen in Parinaud's conjunctivitis, except for the absence of enlargement of the preauricular lymph nodes, which is usually present in this disease. Mollers† has reported 2 cases of Parinaud's conjunctivitis, in which he demonstrated the presence of tubercle bacilli in the granulations by animal inoculation, and in this report quotes the previous work of Wessely and others, who had proved the tuberculous nature of this disease. In this case the ordinary local tuberculin tests would not have assisted in diagnosis, as a positive reaction would have been obtained from the infection in the lungs, and although a subcutaneous test

* *Lancet*, May 18, 1912, No. 4629, clxxxii, 1319.

† Veröffenthichungen der R. Kochsche Stiftung, Heft 4, 1913.

might have produced a focal conjunctival reaction, its use was contraindicated, owing to the danger of a general reaction on the pulmonary condition. The characteristics of the conjunctival lesion, the resistance to ordinary treatment, the presence of extensive tuberculosis elsewhere in the body and the marked focal reaction to tuberculin, followed by recovery, appear to justify the conclusion that the condition was a tuberculous one.

There has been much discussion and confusion as to the nature of the tuberculin reaction and as to how tuberculin aids in the cure of tuberculosis. Certain facts about the action of tuberculin are known, and a great many have been assumed without proof or sufficient experimental confirmation. Among these latter may be mentioned the production of antibodies of one kind or another in the serum and the development of a condition akin to anaphylaxis. The first of the known facts is that tuberculin has not a primary toxic action, even when used in enormous doses, on normal animals or persons, that is, on animals free from tuberculosis. Hamburger* reports having given 500 mg. of O.T. subcutaneously, without producing any general effects, to a child, which had failed to react to a previous skin test and which could, therefore, be considered non-tuberculous. Krause, working in the Saranac Laboratory, administered 25 c.c. of watery extract of tubercle bacilli intravenously to a normal guinea-pig without ill-effects, except for a watery diarrhea lasting a few days and caused by the rapid increase in the amount of fluid in the body. It may therefore be repeated that tuberculin has no deleterious effect on normal animals. Secondly, the presence of anatomic tubercle alters the body in some way so that all the tissues acquire a hypersensitiveness to tuberculin. This allergic condition or hypersensitiveness disappears when the tuberculous focus is completely healed or removed from the body. Thirdly, tuberculin acts specifically on tuberculous foci themselves, causing an acute inflammation in and around them.

* *München. med. Wochnschr.*, 9 Juni, 1908, No. 23, I, 1220.

These focal reactions may be seen in experimental animals, killed during a general tuberculin reaction, and also are observed clinically in cases of tuberculosis where the disease is capable of direct observation, as in laryngeal and skin tuberculosis. The hyperemia accompanying this focal reaction permits of a dissemination of substances whose nature is not yet definitely known, and the entrance of these substances into the systemic circulation produces what is known as the general tuberculin reaction. The focal reaction thus produced by tuberculin may be a source of danger if the reaction is so great as to lead to a dissemination of bacilli to previously healthy tissues. On the other hand, if these reactions are slight and controllable the result of the inflammation is a tendency to walling off of the diseased focus by fibrosis, which is what we know as healing. The immediate object of tuberculin treatment should therefore be the production of slight and controllable reaction around the focus of disease. While this is simple when thus stated, it is not so simple in practice, particularly in pulmonary cases, for we are here dealing with a multiplicity of small foci in varying stages of development, from early and recent cellular tubercles to older, more or less fibrous or caseonecrotic tubercles, which will be influenced differently by the same dose of tuberculin. If we add to this difficulty the fact that our methods of observing and estimating the results clinically are relatively coarse and depend chiefly on the patient's subjective symptoms, the difficulties and chances of error in judging the effects of our dosage are apparent.

The case here reported shows the beneficial results of such focal reactions, and a clearing up of the granulations was noticeable after each reaction. In this case it would have been unwise to give tuberculin subcutaneously on account of the extent of the disease in the lungs, but fortunately the location of the disease in the conjunctiva permitted of direct application and direct observation of the results. As the reaction was purely local, the beneficial results cannot be attributed to changes in

the serum nor to an alteration in the so-called general resistance of the system, but must be ascribed to local tissue changes. Whether a non-specific irritant, which would have produced an inflammatory reaction, would have brought about similar beneficial results cannot be stated or denied, as it was not tried, but the use of jequirity in granular eye conditions is an old method and might give grounds for the belief that this or other non-specific inflammation-producing remedy might have been equally efficacious.

DISCUSSION.

Dr. J. H. Elliott: We have not had many papers dealing with the results from tuberculin. Dr. Paterson's paper on the local application of tuberculin in eye conditions recalls to me the number of cases that are turning up continuously in the chest clinic in Toronto, where the eye man, after treating locally certain cases of keratitis and of phlyctenular conjunctivitis and finding them resistant to that treatment, sends them over to the chest clinic, and no case has failed to respond to tuberculin treatment. The tuberculin has been 1–100,000 dilution of emulsion or of the old tuberculin. We give 1/50 c.c. and rarely over ½ c.c. of that dilution. In St. Michaels we have had many cases referred from the surgical clinic. In a number of cases of tuberculous peritonitis where operation has resulted in a fistula which has failed to close under local applications for months, a large proportion of these heal up promptly under the use of tuberculin. A similar case of chronic discharging sinus was referred to us following the removal of a tuberculous pyosalpinx. The patient had a discharging sinus for many months. Under tuberculin it closed up after a few injections. The removal of tuberculous glands of the neck is often followed by sinus; a large proportion of these heal under treatment with tuberculin. Another interesting case was a man who had tuberculous disease of the sternum followed by abscess in the mediastinum. The abscess was relieved by trephining the sternum. It left a tuberculous ulcer which did not heal under local treatment. It cleared promptly under tuberculin, leaving a depressed scar. Cases of Pott's disease, etc., which have been resistant to surgical treatment have done wonderfully well under treatment with tuberculin. And in one other condition I want to speak of the use of tuberculin: in certain cases of bilateral and therefore inoperable tuberculosis of the kidney. The patients have distressing symptoms of dysuria, frequency increased, frequently every 15 or 30 minutes up to two hours. My first experience was with a patient who had been told by her surgeon that he thought tuberculin was the only thing

that could do her good; he could not do anything with surgical treatment. When I went see to her I found her with a temperature of 103°. I had to do something. The case was hopeless. I gave one 1/20th milligram O.T. intracutaneously as we use for the skin test. I watched the reaction, and to my surprise in three or four days she felt better and had no dysuria and wanted more tuberculin, and I gave her more, and since then with tuberculosis of the genito-urinary tract irrespective of fever we have given tuberculin O.T. 1/20th milligram intracutaneously, and in only one case have we failed to secure great relief for the patient.

Dr. R. C. Paterson: I would like to ask Dr. Newton how he has used tuberculin. I believe that the beneficial effects are due to the inflammatory reaction, and if you use such small doses that you get no inflammatory reaction, then you are going to get no result, and it is this over-cautious use that has led to its disuse. The subcutaneous use of tuberculin I have not touched upon, but in this case we couldn't use tuberculin subcutaneously on account of the advanced condition of the lungs, and we used local treatment which was followed by focal reaction and clearing up of the trouble.

Dr. R. C. Newton: The method we have used: we begin usually, we make it in dilution; the dilutions are 1 in 10, 1 in 100, 1 in 1,000, 1 in 10,000 1 in 100,000 and 1 in 1,000,000. We begin with ten c.c. of the 1 to 1,000 dilution, and that is usually the safest dose. If you get a reaction from that, it is usually so mild that no harm is done. I have seen cases of reaction violently to that dose. Then we go to one to a million cubic centimeters.

The greatest care must be used in cases of pulmonary involvement; in a gland or bone involvement it is easy work, and in eye work it is easy, and oculists use it and have great faith in it.

The doctor has touched on one fact that people who use it too timidly get no result, and it provokes a hypersensitiveness to the remedy, and so it is a very nice point and it takes a great deal of experience for a man to be sure of the dose. It is a wonderful remedy but it is double edged.

The case the president related reminds me of a case of a woman who had nephrectomy and who was sent to the polyclinic. The surgeons could do nothing with her, and the patient wandered into the tuberculin clinic, and so it becomes a last case, and if you report that as a tuberculin case carried out faithfully, it is bad for our cases. This paper is bad because we treated cases as a last resort.

I met a man on the street the other day who was a carpenter and he said: "I have taken tuberculin every week for two years and every time I take it I have to go to bed, and now I am well. About the time I was taken sick four of my acquaintances had the same disease and all of them are now dead."

To finish the case of the woman, who was a very intelligent woman: She came into the polyclinic because she could not stand it. She was in terrible pain and her water was passed every ten minutes, and she had to spend her life sitting on a commode. After two or three years' treatment that woman was apparently well, and the chief of clinic asked her to finish her course of tuberculin—that it was her duty to finish the course, and she told me she was perfectly well. She had irritation of one kidney and cystitis.

Now a remedy that will do that will do a great deal, but we have to be awfully careful in our lung cases.

Dr. H. M. Kinghorn; Saranac Lake, N. Y., read a paper (from manuscript) on "Comparative Results Obtained in the Treatment of Pulmonary Tuberculosis by (1) Graduated Labor; (2) Bed Rest Treatment; (3) Rest and Exercise Treatment."

COMPARATIVE RESULTS OBTAINED IN THE TREATMENT OF PULMONARY TUBERCULOSIS.

I. By Graduated Labor as Employed at the Brompton Hospital Sanatorium at Frimley, England.

II. By Bed Rest Treatment.

III. Rest and Exercise as Employed by Most Sanatoria.

By HUGH M. KINGHORN, M.D.,

SARANAC LAKE, N. Y.

The treatment of pulmonary tuberculosis by graduated labor has been systemically carried out at Frimley, England, for a number of years, and this method of treatment has had considerable influence on a number of lung specialists in this country. Dr. Marcus Paterson was in charge of the sanatorium at Frimley during the early years of its existence, and it is largely due to his work and writings that graduated labor has been used in England and America. Of the patients treated at Frimley, a great majority first passed through the wards of the Brompton Hospital in London, whence, if found suitable after a period of observation, they were drafted on to the sanatorium. They were not chosen at random, still less was every case of pulmonary tuberculosis at Brompton passed on in turn; on the contrary, the cases were carefully selected, only those patients being chosen who were free from fever or other constitutional symptoms, who possessed considerable vitality, and had begun to show signs of improvement. So far as possible, also, patients with signs of limited disease were preferred, although it was soon found that patients with extensive disease, but of a quiescent type often did remarkably well.

I was struck with two prominent facts while reading Paterson's book. The first was that he paid more attention to the

physicial condition of his patient than he did to the foci of disease. He repeatedly emphasizes the fact that the physicial condition is of much greater importance than an examination of the lungs. The second fact was the great importance he placed on the auto-inoculations which were obtained from exercise and work. These two facts are absolutely opposed to my interpretation of the modern method of treating pulmonary tuberculosis. In my judgment a physical examination of the lungs is the only sure way that one can get a knowledge as to how the foci of disease are acting. It is a common occurrence to have patients consult us who are in good muscular physical condition and at work and yet we find a slowly progressing disease. It is impossible to know how the disease is acting without a careful physical examination of the lungs. My principal object in treatment is to treat the foci of disease, but not to neglect but to also treat the general physical condition. My chief aim is to change an open into a closed tuberculosis or an active into an inactive one. I believe that this is accomplished more surely and with better permanent results by rest than by graduated labor. I am quite aware that Paterson gave bed rest treatment to his cases with active disease, but when these cases became quiescent, he paid more attention to their physical condition than to the lung condition.

The second fact which Paterson emphasized very strongly was the value of the auto-inoculations obtained from graduated labor. This is also absolutely opposed to my interpretation of the modern treatment of pulmonary tuberculosis. My aim is to avoid auto-inoculations in every way possible, and to get the foci of disease quiescent as quickly as possible. Auto-inoculations are the results of congestion of the foci in the lungs, and it is just these congestions which are extremely dangerous and which we should try to avoid. We have no known way of controlling auto-inoculations, and it is a well-known fact that one severe over-exertion will sometimes cause such a serious congestion of the disease as to produce a fatal result. It is my firm conviction

that the attempt to treat pulmonary tuberculosis by means of auto-inoculations is extremely dangerous and absolutely contrary to the safe method of placing the foci of disease in a quiescent condition as quickly as possible and keeping them quiescent.

Bed rest treatment has been carried out very successfully by Dr. Joseph H. Pratt of Boston. His results were obtained in the homes of the sick poor in a supposedly unfavorable climate. Supervision was maintained by the class method. There was no selection of cases. In thirty-six per cent. the disease was far advanced when the rest treatment was begun. The average duriation of bed rest treatment was about four months, and the duration of graduated exercise combined with bed rest four to seven months, making the usual duration of treatment from eight to eleven months. A few patients were not allowed to take regular exercise for from one to two years. Strict obedience to the rules was required. Pratt included in the tabulating results those who were dismissed because they did not follow the rest treatment faithfully, those who left the class voluntarily, as well as those who died while taking the treatment. Eighty-eight per cent. of those admitted in the first stage were well and working one to two years after their discharge, sixty-two per cent. of the second stage, and twenty per cent. of the third.

In the period of ten years ending July, 1915, Pratt treated one hundred and ninety-one patients. The condition of those patients one to ten years after their discharge is given in Table I.

The cases selected for the comparison of the effect of prolonged bed rest with graduated work are those in which the wage-earning power had been restored while under treatment (Table II, Chart I). Many of the patients treated by Paterson at Frimley did five hours of hard labor a day before leaving the sanatorium without any apparent ill effect. After returning to work, a large number of them broke down within the first two years. The rapid drop in the percentage of patients well and working is well shown on the chart in the sharp and sudden drop from one hundred per cent. at the beginning to sixty-two per

cent. at the end of one year and fifty per cent. in two years. In Pratt's cases, there was a drop from one hundred per cent. at the beginning to ninety-five per cent. at the end of one year and ninety-two per cent. at the end of two years. Pratt's figures show very clearly the important fact, namely, that strengthening a man's muscles and improving his general condition by graduated labor is not the best way to heal the tuberculous foci in the lungs. His chart and tables clearly show that prolonged rest leads to permanent recovery in a large proportion of the cases treated.

At the end of one year, after discharge there were 593 (61 per cent.) of the Brompton cases and 40 (95 per cent.) of the Pratt cases well and working. At the end of the seventh year, there were 5 (23 per cent.) of the Brompton cases and 21 (70 per cent.) of Pratt's cases well and working.

These results obtained by Pratt illustrate the great value of rest treatment over graduated labor. Pratt's figures also demonstrate another very important fact, namely, that patients who undergo prolonged and intensive rest treatment do not tend to relapse.

It is the constant experience of most physicians who treat pulmonary tuberculosis at health resorts that the home treatment of the disease is most frequently extremely bad. As a rule, the specialist at the health resort is more skilled than the physician in the city in the treatment of this disease, and the routine of the open-air treatment can be carried out much better in the sanitarium or health resort than at home. Pratt's results, however, show that he obtained results at home by his bed rest treatment which are superior to those obtained in the same climate at the Rutland Sanatorium in Massachusetts, and at the Massachusetts State Sanatorium. His results are also equal to those obtained at the Trudeau Sanatorium at Saranac Lake, N. Y., and at the Laurentian Sanitarium at Ste. Agathe des Monts, P. Q., Canada.

The patients at Rutland Sanatorium in Massachusetts were

drawn from Boston and its suburbs and lived, when at home, under the same social and economical conditions as did Pratt's cases. Rutland Sanatorium, although limited to favorable cases, had less than 25 per cent. of its patients well and working eight to ten years after their discharge, while 59 per cent. of Pratt's cases were well and working after this length of time.

Among a large series of patients from Boston and vicinity who were treated at the Massachusetts State sanatoria, Miss Farmer found that twenty-four per cent. were well four to seven years after their discharge. Of Pratt's cases there were sixty-three per cent. who were well four to seven years after their discharge.

I will now briefly compare the results obtained by graduated labor with those obtained by the modern rest and exercise treatment, as employed at most sanatoria. For purposes of comparison, I will take two sanatoria, which use rest and exercise, but which do not allow their patients any manual labor. The exercise consists of walking exercise practically entirely. These two sanatoria are Trudeau Sanatorium at Saranac Lake, N. Y., and the Laurentian Sanitarium at Ste. Agathe des Monts, P. Q., Canada. The class of patients admitted to these institutions is the same and the methods of treatment are identical. Rest treatment is used very thoroughly where indicated, but not so intensively as employed by Pratt.

By taking an average of the percentages for the seven years of the Frimley results, we find that forty-four per cent. of the patients discharged during a period from one to seven years were well and working. Table IV shows that during the period of one to ten years, the Adirondack Cottage Sanitarium (Trudeau Sanatorium) shows that sixty-one per cent. of patients were well and at work. Table V shows that fifty-six per cent. of the patients who were discharged from the Laurentian Sanitarium were well and working during a period of one to nine years.

Here again we have convincing proof that rest treatment is much superior to graduated labor treatment.

It still remains to compare the intensive bed rest treatment as employed by Pratt with the usual rest and exercise treatment. We see from Table I that Pratt had a total of 191 patients and that of these 107 (56 per cent.) were well one to ten years after discharge. The Adirondack Cottage Sanitarium (Trudeau Sanatorium) has a total of 1,929 (Table IV) and of these 1,195 (62 per cent.) were well one to ten years after discharge. The Laurentian Sanitarium (Table V) had a total of 558 patients, and of these 295 (56 per cent.) were well one to nine years after discharge.

It is thus seen that the results obtained by the intensive bed rest treatment as employed by Pratt are the same as those obtained by the ordinary treatment of rest and exercise as employed at the Adirondack Cottage Sanitarium and at the Laurentian Sanitarium. A critical examination of Pratt's bed rest treatment and the usual rest treatment shows that the two methods are practically the same. Pratt employs bed rest treatment to all his cases and the others employ it only where indicated. The difference is, therefore, only one of degree. The results are the same.

TABLE I.

EMANUEL CHURCH TUBERCULOSIS CLASS: STAGE OF DISEASE AND CONDITION OF ALL CASES, ONE TO TEN YEARS AFTER DISCHARGE, INCLUDING THOSE WHO DIED WHILE UNDER TREATMENT IN THE CLASS.*

Stage.	Total No.	Per Cent.	Condition July, 1916.			
			Well.	Living.	Dead.	Per Cent. Well.
I.....	67	35	59	2	6	88
II.....	55	29	34	2	19	62
III.....	69	36	14	9	46	20
Total.....	191	100	107	13	71	

* Seventy-six per cent. of the first and second stage cases were well. No first-stage patients died in the class. All the cases were traced.

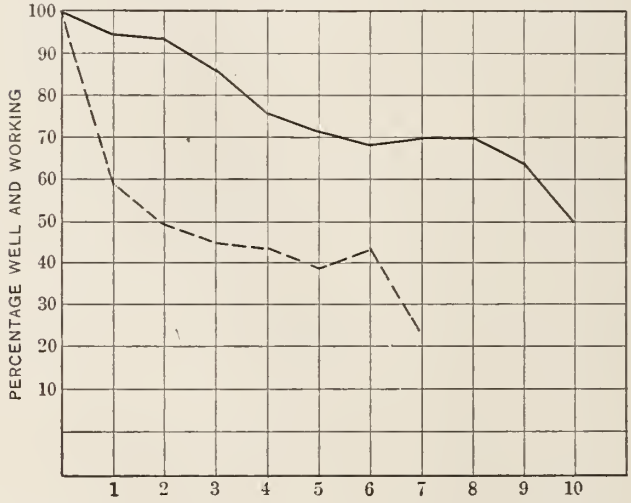
TABLE II.

After-Condition of Patients with Tubercle Bacilli in Sputum, Discharged with Wage-Earning Power Restored.*

No. of Years After Discharge.	Brompton Hospital Sanitorium; Treatment, Graduated Labor.				E. C. T. C.; Treatment, Prolonged Bed Rest.		
	Total No. of Cases.	No. of Cases Minus those Lost Sigbt of.	Number Working.	Per Cent. Working.	Total No. of Cases.	No. Working.	Per Cent. Working.
1	1051	965	593	61	42	40	95
2	1051	868	434	50	39	36	92
3	741	581	265	46	39	34	87
4	475	344	153	44	38	29	76
5	292	209	81	39	34	24	71
6	150	96	40	42	32	22	69
7	39	22	5	23	30	21	70
8					20	14	70
9					14	9	64
10					8	4	50

TABLE III.

Number of Years Since Discharge.



Patients with tubercle bacilli in sputum discharged with earning power restored. Solid line, Emmanuel Church tuberculosis class; broken line, Brompton Hospital Sanatorium.

* In the Brompton table those lost sight of have been deducted in determining the percentage working. There were none lost sight of in the Emmanual Church Tuberculosis Class.

TABLE IV.

CONDITION OF ADIRONDACK COTTAGE SANITARIUM PATIENTS ONE TO TEN YEARS AFTER DISCHARGE (1916–1916).

Stage.	No. of Cases.	Well.	Per Cent. Well.
I.....	719	515	72
II.....	1,166	669	57
III.....	44	11	25
	1,929	1,195	

TABLE V.

Of 558 patients who have been treated in the Laurentian Sanitarium for a period of thirty days or longer, since 1908, 529 have been traced, and are classified, as follows:

	No.	Per Cent.
Living and leading active lives	295	55.8
Still invalided	104	19.6
Total living	399	75.4
Died	130	24.6
	529	100

29 patients could not be traced.

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DISCUSSION.

DR. J. B. HAWES, 2D: I can speak frankly in the presence of this group of gentlemen. I am quite familiar with Dr. Pratt's work, and I have worked with him. Dr. Pratt has made certain statements which I do not agree with, and which I do not think he can back up.

have told this to him personally, and he knows how I feel about it. Dr. Pratt says his patients are not selected; I say they are selected in the finest sense of the word, in that he will not accept anybody in his class who will not do exactly what he says as to every detail. Dr. Pratt accepts no patient who will not stay in bed as long as Dr. Pratt thinks necessary. This is "selection of cases" of strictest kind. The application of every patient entering our state sanatoria has to go through my hands. If I could make the selection that Dr. Pratt does, I think we could guarantee as good results as he has had. I do not think that Miss Farmer's figures show recent results. If he will refer to the work of Miss Billings' and myself, he will see that our figures are very different. I do not think it is fair to the State of Massachusetts or to our sanatoria to compare a small group of Dr. Pratt's patients carefully selected with a group of patients who are not selected at all. At our state sanatorium at Rutland there are 350 patients and four doctors; this is not close supervision.

Dr. V. Y. Bowditch: I want to say that greatly as I admire Dr. Pratt's work, I think it is not fair to make comparisons. It is hard to get proper conditions to make comparisons, and it is not fair to make such comparisons.

Dr. J. H. Pratt: I have published for comparison the results obtained at the Rutland Sanatorium and in the Emmanuel Church Tuberculosis Class, showing that better end results were secured in the class although the patients were at home. Dr. Hawes has concluded from this that I am opposed to sanatorium treatment and has so stated in print. I am not. I believe in sanatorium treatment when strict rest in active cases is an essential part of that treatment. I know it is easier to secure supervision in a sanatorium than in a home. The comparative statement of results which Dr. Kinghorn has given in his paper show clearly it seems to me that bed rest in the open air at home yields better results than the out of door treatment without strict rest in a sanatorium. It is true that we refused to admit patients to the class who would not follow the strict rest treatment, but the number of applicants who were not accepted for this reason was small. I gave exact figures in a paper I read before the National Tuberculosis Association two years ago. After new patients attended one meeting of the class where they saw the improvement the members were making under rest it was rarely difficult to induce the new comers to begin the bed treatment.

The percentage of arrested cases reported from Rutland is lower than in the sanatoriums where more rest is employed. If strict rest were used in active cases at Rutland I am convinced that the results of treatment would be much better.

Dr. W. L. Dunn: I simply say this: That in the more than twenty years I have been in this work I find myself going more and more to the rest end. I started, as everybody did, with only putting the fever patient to bed. As years have gone by I have gone to the side where I have put literally every one of my patients to bed at the beginning. I know that the differences in my results have justified it, and it is very clear for us in our work that the more we have emphasized the rest side of it the better our results have been. Most of us have made the mistake that a temperature rise was the main indication for putting a patient to rest. I think there are many reasons for putting a non-febrile patient to rest. It gives them the hardest thing to do first. It puts them in earnest, and to the patient who has been put to rest at first, every step in cure is an addition to his liberties. And after all fighting tuberculosis is just as much a soldier (?) fight as a spirit fight, and when you get them into the right spirit, the patients get into the right spirit. I do not think it is so difficult to keep patients at rest. I found it very easy because patients know when they come to me that that is what they are going to get and they are ready to take it, but I am thoroughly convinced that my results fourteen years ago do not compare with my results today, and I am sure it is due to rest treatment.

Dr. N. K. Wood: I conducted a class. I agree with Dr. Hawes. It is one of the standards that those types treated are useful men and women and will become useful men and women if returned to health. I do not think there is any question but that the results Dr. Pratt has tried to bring about are good. But I think in order to do it, we have to have cases that submit to discipline. As we are speaking among friends, everybody knows that there are conditions put upon doctors as to what they can do and not do. Patients come home from our sanatorium and tell us what they think about it, and many cases have left the sanatorium on account of discipline, and it is not a question of discipline all the time but sometimes of political influence.

Dr. R. C. Newton: Dr. Pratt's patients are cured in the climate in which they remain; getting well in the climate, they are well. It is a matter of training, and Dr. Pratt does not lose sight of his cases. Dr. Pratt is probably doing that and he has been getting remarkable results and he should be given credit, and I think the point of climate should not be overlooked.

Dr. L. Brown: Another point I should like to say that you might make some criticism of how Dr. Paterson selected his cases. Dr. Paterson selected his cases not on account of the physical findings in their lungs. He would take cases with cavities in their lungs and he had a number of such cases that would not have a chance to get into

Trudeau, but he took them and put them through these tests that Dr. Kinghorn mentioned. He took in cases from the laboring class, men who went home to poor hygienic surroundings; and right there is a tremendous thing of importance: it is the amount of money that a man has and the training that the inmates have had, and that is where Dr. Pratt's methods are better. The individuals at home have all adjusted their lives so that this man can get well. When a man leaves a sanatorium I have one in mind of a porter who had a wife and eight children, and his family knew nothing about taking care of him. What chance did he stand? He broke down very quickly.

I feel very much as Dr. Dunn feels, that the further I go on, the more I feel that giving my patients rest and rest in bed at first, especially six weeks in bed at the beginning, but not rest in bed for advanced cases. If you can take that case and put him into bed, you have gotten him over the time when he is liable to make mistakes. After that time your problem is much simplified. We have taken cases and put them in our rest squad and we try to select the cases, and subject them to a six weeks' rest in bed. We hope in a year or two to have enough statistics to prove whether a rest of six weeks in bed is better than a sanatorium treatment.

I believe if you should give them six weeks rest in bed, you can increase their exercise more rapidly and return them home in better condition.

Dr. Jay Perkins: I have had an opportunity to see results of patients who have returned home from sanatoriums. I know the lack of observation. They are not under any observation whatever when they come from poor families. Now Dr. Pratt does have that observation; and, as Dr. Newton mentioned, not sufficient stress has been paid to it. I believe that the results all come from that follow-up treatment.

Dr. W. R. F. Phillips: What is the purpose of the whole thing—rest and exercise? I think we forget what is the whole purpose of the rest and exercise. If we have a diseased lung we do not, or ought not, work that lung. Why? Because every time we work it we tear down what nature has built up; when we rest it we give nature a chance. After that we can give them a little work. I learned a long time ago that if I wanted to get well from tuberculosis, I should rest and I am here now.

Dr. I. H. Hance: I have had an opportunity of treating four or five tuberculous throat cases and I have emphasized in my own mind the value of rest, because in two of those patients I got the rest, one completely and the other pretty completely. The others, I could not get them to stop talking and they progressed right along. In one who

did stop talking it did quiet down and then unfortunately it commenced to blaze up again, and the other I told her that she had been using her voice and she said she had, and you could see the increase in the congestion of her vocal cords every time, and by her persistent efforts of keeping still she got well. I have seen a result in a bad case of tuberculosis of the cords and also of the posterior commissure which quieted down most satisfactorily and I know I would not have got any result with her unless she had rested her voice.

Dr. C. D. Parfitt: I would like to call your attention to rest from talking. Quite recently a patient discharged two years ago wrote me that he had at last overcome his frequent relapses. He had had a disease of two years' standing, and he would relapse on the very slightest exercise, like going up and down stairs twice a day. He wrote me after going home that it was not exercise that upset him but it was talking; and since he has suppressed his talking he has now for nine months been free from relapses, and has been able to take exercise for an hour and a half a day.

Dr. J. H. Elliott: I had some sanatorium experience and now I am seeing the results of other men who are carrying on sanatorium work. When a patient comes to me and asks me to carry on treatment after a period of sanatorium treatment, and the family ask me what he can do, my prognosis depends on the sanatorium from which that patient comes. If that patient has had a long rest, we do not seem to get the same results as in the case of the one from the sanatorium where they had run up the exercise as much as possible. Again and again with patients who have come from a sanatorium, if you put that patient to bed not for six weeks but for six months to a year, you may be able to secure a condition of abacillary sputum which you could not secure without that rest.

Dr. H. M. Kinghorn: I would like to mention a very important fact that was called to my notice a few weeks ago by Mr. Sampson of the Adirondack Cottage Sanatorium. We happened to be talking on rest and exercise; and he told me it was astonishing what changes he found in his x-ray pictures after the patient had been put to complete rest in bed, that the x-ray shows a remarkable clearing up of the foci of the disease. After the patient has been put to rest in bed, it is astonishing how it clears up. Now referring to the great figures in tuberculosis work, referring first of all to Brehmer's advice "exercise so as not to get tired." We will often hear a physician say "Exercise as much as you like." You do not tell a well man "Exercise as much as you like." You limit the exercise. I do not believe it is wise to allow any patient to exercise more than forty minutes to an hour at a time. That amount will do him good, more will do him harm. Det-

weiller was the great exponent of the rest and reclining treatment. Then Trudeau was the great exponent in this country of the rest treatment. He would find that a relapse would come when over-fatigued. Then he used the rest treatment, and it was always his practice to carry out the rest reclining treatment. A point which I feel strongly about is to keep our patients longer and employ the rest treatment longer. I am convinced that the rest treatment is infinitely better than the labor treatment. You have not only got to get the patient well but also to keep him well, and I feel that we should push the rest treatment to an extreme degree as the sanitarium treatment is too short, and after the rest treatment put the patient in a suitable climate.

In *London* we find that the results are bad with the men who had graduated labor. Now they are trying to put them in suitable climates. They should keep them longer and put them in suitable climates.

Dr. C. H. Johnston read a paper (from manuscript) on "Cardiac Conditions that Disqualify for Army Service."

CARDIAC CONDITIONS THAT DO NOT DISQUALIFY FOR ARMY SERVICE.

By COLLINS H. JOHNSTON, F.A.C.P., M.D.,

GRAND RAPIDS, MICH.

It is evident to anyone in touch with the examination of recruits that no inconsiderable number of men with impaired hearts are being passed into our new armies and the experience of foreign countries has shown that many soldiers whose hearts were damaged before the war have broken down under the strain of active service. This entails a great loss to the army and an unnecessary increase in the financial burdens of the country.

Most hearts with an organic lesion present such unmistakable physical signs that a correct diagnosis is not difficult. This is especially true when diastolic murmurs are present and the government has directed that recruits with such murmurs be rejected for all military service. But many impaired hearts present no physical signs whatever and in these cases symptoms become of especial importance. Realizing, however, that it is easy for a shirker to exaggerate his symptoms, some cardiovascular experts on draft boards and at cantonments, in the absence of physical signs, discount symptoms in great measure or ignore them altogether. A considerable number of recruits complain of symptoms, especially shortness of breath, palpitation, and precordial pain, in whom no signs of impairment of the heart are found on physical examination. But a diagnosis of heart disease should not be made from symptoms alone. Hence it is not surprising that in the limited time given to the examination of each recruit a considerable number of impaired hearts should escape detection. It seems, therefore, an opportune time to discuss some of the cardiac problems presented to

examining boards and I cheerfully accepted our president's invitation to open a discussion with a brief paper on "Cardiac Conditions that do not Disqualify for Army Service."

Diastolic murmurs with practically no exceptions are indicative of organic lesions. Systolic murmurs, on the other hand, may be functional or organic. Functional murmurs at the apex may disappear on exertion, but exercise often brings out a functional murmur which entirely disappears with a few moments rest in the horizontal position.

Thayer says that apical systolic murmurs which are heard in the recumbent position and disappear when the individual stands up are not of any pathological significance in the absence of other signs of cardiac involvement and that in true mitral disease such murmurs, if modified at all, become a little louder in the erect posture. On the other hand functional murmurs often disappear when the patient is lying down, while an organic murmur, especially that of mitral stenosis, may be audible only in the latter position. Accentuation of the second pulmonic sound is also often more readily recognized in the prone position. It seems evident therefore, that every case of suspected valvular disease should be examined in both standing and prone positions for their bearing upon murmurs as well as their effect upon the heart rate, and to avoid overlooking the present murmur and thrill of mitral stenosis the heart should be examined while the subject is holding his breath at the end of forced expiration.

Aortic stenosis must not be diagnosed from the mere presence of a systolic murmur which may be due to roughening of the aortic cusps or orifices, dilatation of the aorta just above the valve, thickening of the valve from arteriosclerosis, pressure upon the aorta by a mediastinal tumor, or anæmia. Other physical signs of aortic stenosis must be present such as the characteristic slow pulse, hypertrophy of the left ventricle, systolic thrill and a feeble or absent second sound. You must not forget that the point of maximum intensity of the murmur

of aortic stenosis may be in the pulmonary area where it may be mistaken for pulmonary stenosis or patent ductus arteriosus.

When a systolic mitral murmur is typically rough and loud and low pitched, and is transmitted to the axilla, and occupies the entire systole, thus replacing the first sound, and when the murmur is accompanied by a thrill and accentuation of the second pulmonic sound, and especially if there is a history of one or more attacks of rheumatic fever or other acute infections, organic valvular disease should be strongly suspected. But incompetence of the mitral valves leads to varying degrees of enlargement of the heart so regularly that without it no systolic murmur at the apex, whatever its character, intensity or propogation should be considered indicative of mitral regurgitation. Exceptions to this rule are so rare as to be almost negligible. In addition to this the apex beat is usually displaced to the left and its force increased. There is also usually accentuation of the second pulmonic sound. By far the most important of these associated conditions is enlargement in the size of the heart without which a systolic murmur at the apex should be entirely disregarded and must not be considered sufficient ground for rejection for military service.

A diagnosis of hypertrophy should not be made merely from a displacement of the apex beat as this may be due to extrinsic causes such as adherent pleura, pleural effusion or pneumothorax. Neither should it be made from an increase in the area of pulsation alone as this may be due to extrinsic causes also. The only pathognomonic sign of hypertrophy of the left ventricle, as far as the apex is concerned, is increased force of its impulse, which may be hidden by overlying lung in emphysema, a thick chest wall, etc. A large diffuse apex beat with a forcible, thrusting, heaving impulse and extension of the area of dullness to the nipple line or beyond it, are characteristic of dilatation and hypertrophy of the left ventricle. "An apex beat in or just outside the nipple line, with a forcible protusion during systole, may be taken as evidence of moderate hypertrophy."*

* "Principles and Diagnosis of Heart Affections," Sir Jas. McKenzie, p. 132.

In nervous recruits the heart often beats rapidly and with an *appearance* of increased force, but on palpation it will be found that the beat is light and weak. But slight degrees of cardiac hypertrophy are not always easy to recognize. A recruit whom I recently sent to a cantonment with a diagnosis of functional mitral systolic murmur and in whom a radiograph showed the heart to be *normal* in size was returned with a diagnosis of "mitral regurgitation, moderate degree of cardiac hypertrophy."

Having used the x-ray for several years in the diagnosis of enlargement of the heart and wishing to know what method was preferred by the cardio-vascular division of the army, I sent a letter of inquiry to the Surgeon-General's Office and received the following reply: "If the x-ray is to be used in an attempt to determine accurately the size of the heart the plan and tables recommended by Professor C. R. Bardeen in the *American Journal of Roentgenology* for December, 1917, is probably the most accurate, and certainly the most elaborate."

"In the judgment of the undersigned, however, there is grave question whether the determination of the heart size by means of the silhouette is as accurate and as satisfactory for military purposes as is the method of careful physical diagnosis alone. In the case of seriously diseased hearts and of suspected aneurism the roentgenological evidence is often of great value, but in the case of hearts likely to be encountered in examining registrants for the draft, that is, hearts that are normal or nearly normal in size, careful physical examination gives information so reliable and satisfactory that an additional x-ray examination seems to me, usually, unnecessarily elaborate and time consuming. The question as to hypertrophy is much better answered by the character of the impulse imparted to the palpating hand than by the size of the x-ray shadow. Slight or moderate hypertrophy without dilatation gives an increase in the volume of the heart so slight as to make it doubtful whether it can be recognized by any method of examination, but such hypertrophy does declare itself in the added force and lifting character of the

impulse, even when it is difficult by any method to recognize an increase in size. A roentgenological examination of the heart is by no means free from factors of uncertainty, and, while it sometimes furnishes very valuable information, it seems to me very doubtful indeed, whether, in the case of men being examined for the army, it gives any more accurate information than can be obtained much more rapidly and simply by skillful and careful physical examination."

There is a group of patients in whom there is unmistakable evidence of enlargement of the heart but no indication of valvular or nephritic trouble, and it is by no means infrequent to find patients with apparently perfectly normal hearts which present the electro-cardiographic deviations supposedly typical of hypertrophy. In the young a certain amount of hypertrophy and dilatation of the heart seems to be physiological and does not seem to impair its efficiency. McKenzie compares this physiological enlargement to the increase in size of the muscles of a blacksmith's arm. But enlargement due to any pathological lesion such as valvular disease is *always* accompanied by a weakened heart muscle. In cases of murmur, therefore, in which the examiner is in doubt as to the existence of hypertrophy, and in the lesser degrees of enlargement where no gross lesions are found, as well as in a considerable number of cases with symptoms but in which no definite signs of organic disease can be discovered on physical examination, the important thing to determine is whether or not there is coexistent change in the cardiac musculature with resultant damage to the reserve power of the heart. Has the recruit any myocardial degeneneration? Can he undergo physical exertion without distress? Is he fit for general military duty?

The diagnosis of heart disease is far too often based upon the existence of murmurs. Too much stress is laid upon valvular disease and not enough upon the condition of the myocardium which is the great sufferer in acute rheumatism and other infectious diseases such as scarlet fever, measles, pneumonia and influenza.

Although it is impairment of the myocardium which gives rise to the well-known symptoms of heart disease many such hearts may show no indication of weakness until called upon to do extra work. If a heart is healthy, exercise produces a rise in blood pressure, an increase in the pulse and respiration rate during which their normal ratio is pretty well maintained, and a decrease of about one centimeter in the transverse diameter of the heart.

After hopping one hundred times upon one foot or walking hurriedly up a couple of flights of stairs the normal rate should be resumed within two minutes, the respiration being the first to return, the blood pressure next and the heart rate last. But if cardiac insufficiency is present this return to the individual's normal may take four or five times as long and shortness of breath, precordial pain or distress, vertigo, palpitation or fluttering sensations in the chest may be complained of. The pulse may become irregular and the rate out of all proportion to the amount of exercise taken and the pulse respiration rate is often considerably disturbed. The blood pressure may fail to rise and occasionally dilatation of the heart is observed. "When the exercise is poorly tolerated the patient appears exhausted, is markedly dyspneic, the pulse is very rapid, and its return to normal is retarded. The expression of the face is often quite characteristic; the mouth is open, the lines about the face are exaggerated and the general expression is that of anxiety and exhaustion. Marked general tremor described by the patient as shakiness is a prominent feature in many cases. The symptoms complained of are precordial pain, shortness of breath, giddiness and weakness. These symptoms are not equally prominent, but vary greatly in individual cases. When the exercises are well tolerated the picture is quite different; the appearance of the patient may be quite normal, the dyspnea slight or absent, the pulse rate relatively low with a more rapid return to the pre-exercise rate."*

* *The Military Surgeon*, April, 1918, p. 420.

In this connection I wish to call attention to the fact that Captain S. Calvin Smith of Camp Custer in a study of 35,000 men found that 80 per cent. had pulse rates of 80 or more before exercise. His conclusion was that the average pulse rate of 72 per minute is not the pulse rate to be found in active youths between twenty and thirty years of age and that the radial rate may be expected to be ten or more beats higher than the classical average of 72.

While breathlessness, pain and palpitation are the first and most important signs of cardiac insufficiency, when they are present it must not be concluded that the heart muscle is *always* at fault for many hearts tolerate physical exercise badly at first and some of these symptoms are common to both myocardial weakness and vasomotor instability. Many men who present themselves to draft boards have led sedentary lives and on account of defective development or general nervousness are poorly fitted for nervous and physical strain. Their hearts may be perfectly healthy, but during examination they suffer from palpitation or excited action of the heart, the beat becoming forcible and rapid. Sometimes a systolic murmur may be heard. Exercise may produce excessive fatigue and actual exhaustion, attacks of giddiness or fainting, palpitation and precordial pain. These men show no constant physical signs, but in many of them the heart rate may be abnormally high when up and about and moderate exercise may increase the pulse rate excessively. If told to lie down and breathe deeply and slowly for a few moments, the heart action often becomes less forcible and the rate slower. McKenzie believes that in at least ninety per cent. of these nervous or neurotic subjects the heart itself is not primarily at fault and that the majority of recruits who have heart symptoms do not suffer from heart disease but from physical and nervous exhaustion.

There is also a mental factor in many of these cases which must be taken into account. For instance, I recently examined a recruit twenty-six years of age who came from a local board

with a diagnosis of tachycardia and with a written diagnosis from his physician of "endocarditis with hypertrophy." He had never had any infectious disease. Until three years ago he worked out of doors as a contractor. He then changed his occupation to a sedentary one and began to gain in weight, being 35 pounds overweight when I examined him. A year later he began to be nervous and was troubled with palpitation. He was frequently awakened in the night with precordial pain and would get out of bed and walk the floor a couple of hours. His thyroid was not palpable, but he said my examination of his neck caused pain. Before exercise his pulse was 120. There were no murmurs and no evidence of hypertrophy. After hopping 100 times, which seemed to give him a good deal of general distress, his respirations were rapid, his pulse 150 and a slight apical systolic murmur was heard. The murmur soon disappeared but his respiration remained above normal for several minutes and his pulse remained about 120 as long as he was in the examination room. He had been married a year and his wife expected a baby in a couple of weeks. He admitted his financial affairs were not in good condition and that he did not wish to enter the army. I told him I thought the exercise and out-of-door life would reduce his weight, strengthen his nerve centers and make a new man of him, with which he agreed.

Thomas Lewis has recently proposed the name "Neuro-Circulatory Asthenia" (N. C. A.) for a group of cases "which present a well-defined symptom complex in which certain nervous and circulatory symptoms are associated with an increased susceptibility to fatigue"* which have heretofore been included under the term "Irritable heart of soldiers" or "Disordered action of the heart." These recruits show symptoms which it is not possible to ascribe to any one definite diseased condition. After exercise the usual symptoms of heart trouble are manifest such as breathlessness, fatigue, chest pain, palpitation, giddiness, headache, etc. There is frequently a more or less pronounced

* *The Military Surgeon*, April, 1918, p. 409.

tremor of the hands which is more coarse than that usually seen in exophthalmic goiter. The hands are also often cold and clammy and markedly cyanotic. The subject may be ruddy and vigorous, or of poor build, asthenic and debilitated with a tendency to profuse perspiration. The apex beat may be diffuse or forcible and heaving, but without dilatation or hypertrophy. Pulsation of the epigastrium and the peripheral arteries is common. The heart rate is almost always accelerated, being from 90 to 100 beats or more per minute in the upright position. There is often a striking inequality in the pulse rate brought on by a change from a horizontal to an upright position and the rate may be markedly accelerated after slight exercise. After hopping 100 times the pulse does not return to its normal rate at the end of two minutes. Lewis sums up his description of these cases by saying: "It is strongly recommended, above all, not to transport soldiers suffering from this disorder overseas for active service, as it is well known that their period of service on full duty is short."*

Closely allied to the weak hearts of neurotics or neurasthenics and the hearts of neuro-circulatory asthenia are some of the cases of simple tachycardia and I frequently find them difficult to classify. In some instances they come from the local board with a diagnosis of tachycardia and we find the pulse rate normal at the advisory board. In other cases the heart is rapid before examination and does not slow down after the lapse of several moments in the recumbent posture. In some cases the tachycardia is the only symptom present and is evidently due to excitement or emotion. In others there may be shortness of breath, but the respiratory rate is often proportionately less than the pulse rate. Some have used alcohol and tobacco to excess. Unless the pulse rate is persistently over one hundred and the individual has a definite history of trouble extending over a considerable period and unless definite signs are present on physical examination and providing hyperthyroidism, tuber-

* *The Military Surgeon*, April, 1918, Thomas Lewis, p. 424.

culosis and other acute infections can be excluded, these cases of simple tachycardia should be accepted for military service and we have passed a good many of them on to the cantonments without their being returned.

Without question, however, some of these rapid hearts are due to hyperthyroidism or early tuberculosis. There may be no apparent enlargement of the thyroid gland and but few if any prominent nervous symptoms. Rapid heart and tremor may be the only signs present. It is often however possible to detect a tendency to vasomotor disturbances, a warm moist skin, warm extremities, active capillary circulation and rapid action of the heart, the rate of which is easily increased by any mental excitement. The knee jerks are increased and slight musclar tremors may be appreciable. The individual is easily exhausted both mentally and physically and incapable of sustained effort.

"Graves' disease is above all things a condition of heightened excitability of the vegetative nerves accompanied by disordered metabolism and abnormal action of all organs innervated by them; of the heart, thyroid and adrenals amongst others; but there is no sufficient justification for classifying all cases in terms of thyroid enlargement. The presence of a goitre exhibiting vascular anomalies in association with other evidences of sympathetic irritation and metabolic disturbances leaves no room for doubt as to the diagnosis, nor does the absence of a goitre where sympathetic and metabolic disturbances are marked. But the presence of a goitre with tachycardia alone, or with tremor alone, is not a sufficient ground for the diagnosis of Graves' disease in the absence of other signs of sympathetic or metabolic disorder.*

Cases of simple enlargement of the thyroid with no symptoms of hyperthyroidism should not be rejected; but as we know that sooner or later some of these cases show symptoms, if even a slight degree of tachycardia or tremor are present the individual

* McCarrison, "The Thyroid Gland," p. 225.

should be rejected for general military service however small the thyroid may be. If, however, only a rapid heart is present without the characteristic fine tremor of Graves disease in an individual who is in good general conditions and whose thyroid is not palpable and neuro-circulatory asthenia, tuberculosis and other acute toxic conditions can be excluded, he can safely be accepted.

There was formerly considerable confusion as to the significance of cardiac irregularities, but we now know that certain irregularities are indicative of serious disease while others are of little or no importance. One of the latter is sinus or respiratory irregularity which has a definite relation to respiration, the pulse rate increasing during inspiration and decreasing during expiration. This form of arrhythmia is of no importance and should never be a cause of rejection for military service.

Extra systoles or premature contractions are one of the most frequent causes of irregularity and are often a cause of worry to the individual and sometimes of perplexity to the examiner. Extra systoles and partial heart block account for the vast majority of cases of intermittent pulse or dropped beats and it is important to differentiate between them as the former are rarely if ever in themselves indicative of an impaired heart, while the latter always means a diseased myocardium. The diagnosis can usually be made with a stethoscope. In heart block no sounds are heard during the intermission because the ventricle does not contract, but it is exceedingly rare for an extra systole which is not palpable at the wrist to be so feeble as to produce no heart sounds at all. A heart which shows no extra systoles when at rest, but develops them on exertion is probably the seat of myocardial impairment. But an extra systole in a young man unassociated with any other sign of cardiac disease and which disappears after exercise is not a contraindication for military service.

Practically the only cardiac irregularities which are accompanied by damage to the functional efficiency of the heart are

those due to auricular fibrillation and heart block (McKenzie). There should be no difficulty in differentiating between extra systole and auricular fibrillation, in the latter of which the heart is absolutely irregular as to the time and strength of its beats. If present at the recruit's age auricular fibrillation is usually associated with mitral stenosis and a history of rheumatism. Later in life it may accompany myocardial disease. It always produces a marked effect upon the heart's efficiency and may be recognized by the presence of complete irregularity of the pulse and a poor response to the exercise test. The pulse is usually rapid, but if many of the contractions of the ventricle do not reach the wrist, the pulse rate may be less than normal. When the heart is irregular and the beat 120 or more per minute it is generally due to auricular fibrillation. Extra systoles disappear when the heart rate reaches 120.

Although this paper should be confined to cardiac conditions which do not disqualify for army service, I must refer to a condition which is a disqualification in all cases, but the correct diagnosis of which is at times quite a difficult matter. I refer to mitral stenosis. A typical case is easily recognized by (1) a short presystolic thrill ending in a sharp, abrupt, loud shock; (2) a presystolic murmur often unusually sharp and abrupt, ending in a short, snappy, sharply accentuated first sound and heard over a quite circumscribed area to the right of the apex beat; (3) accentuation and reduplication of the second pulmonic and often a reduplicated second sound at the apex; (4) a heart normal in size, or apparently smaller than normal, or perhaps more frequently enlarged somewhat to the right—occasionally to the left, especially if regurgitation is present. To one examiner there may seem to be a prolongation of the first sound, to another simply a reduplication of the first sound, while to a third the first sound may be so altered as to constitute a systolic murmur. The murmur may not appear until several years after the thrill (McKenzie) and even then may be absent for days at a time. Babcock states that the presystolic murmur of

mitral stenosis is one of the two truthful murmurs, the other being that of aortic insufficiency, but the murmur is not always present to give its testimony when we would like to have it. I have seen Osler hunt four days in succession for a presystolic murmur he wished to demonstrate before finding it. It may be audible only in the prone position or at the end of forced expiration.

In an early case of mitral stenosis which is examined on a day when no thrill or murmur are present, with no enlargement in the transverse diameter of the heart on palpation of percussion, where the possible history of attacks of tachycardia and palpitation, shortness of breath and inability to perform hard work is overlooked and where the accentuation of the second pulmonic sound, forcible action of the heart and shortness of breath are ascribed to nervousness, it is not surprising that the case is passed on to a cantonment. On the other hand, I frequently find a sharp apical slap, an accentuated mitral first sound and a faint, scarcely perceptible presystolic murmur in a recruit who seems to be more or less nervous and excited in the crowded rooms of the advisory board. But when the examination is made some hours later after a period of rest and quiet the heart will appear to be quite normal. Many of these doubtful cases respond in a typical way to the exercise test.

A month ago a recruit came from a local board with a diagnosis of tachycardia. I found nothing wrong with his heart and about to pass him for active military service when he showed me his discharge from a national cantonment with a diagnosis of "mitral stenosis-severe; mitral regurgitation-moderate." While on a visit to the cantonment a few days later, I took the case up with the cardio-vascular expert who said he remembered it well and that the diagnosis had been concurred in by two of his colleagues. The next day I reexamined the man along with two other members of the medical advisory board with absolutely negative results. His blood pressure before exercise was systolic, 104; diastolic, 66. After running up one flight of stairs it was

132–65, two minutes later 102–66. Before hopping one hundred times his pulse rate was 64, one minute later it was the same. There were no accentuated second sounds; no murmurs; no signs of hypertrophy; an occasional extra systole before exercise; none after.

I have been told that at several of the national cantonments cases have occurred in which a diagnosis of mitral stenosis had been made wherein death had occurred from other causes and at autopsy no pathological changes in the heart were found. This would seem to warrant the conclusion drawn by one of my friends "that other changes can cause a cardiac symptomatology and that the short rolling apex first sound may be just as functional as the systolic blows," which we all know are considered functional in so many cases.

Morris and Friedlander have called attention to the fact that a functional presystolic thrill followed by a more or less marked apical systolic shock and associated with reduplication of the first sound at the apex may occur in many perfectly normal hearts while the subject is in the erect position, especially if the heart is beating rapidly. In the recumbent position, on the other hand, particularly if the heart has slowed down, these signs almost if not entirely disappear, but the second pulmonic sound not infrequently becomes accentuated and reduplicated. No presystolic murmurs, however, are heard in these cases, there is no enlargement of the heart, the response to exercise is normal and no symptoms are complained of on exertion. These hearts are therefore considered to be normal. In view of these findings and of the fact that the presystolic murmur of mitral stenosis is not always present and that the second pulmonic sound is accentuated "in about half of the cases between the ages of twenty and twenty-nine,"† and wishing to know what course to follow in doubtful cases, I wrote the Surgeon-General's office for instructions and received the following letter from Colonel

* *Journal of the American Medical Association*, August 3, 1918, p. 375.

† Cabot, "Physical Diagnosis," p. 172.

Frank Billings:—"In my opinion the diagnosis should not be made unless there is found on repeated examination a rather typical presystolic murmur and thrill with the characteristic accentuation of the pulmonic second sound. The individual who has mitral stenosis will never respond well to the exercise test.

"Mitral stenosis is simulated by the physical signs of functional disturbance of the heart due to a general unbalanced nervous apparatus, often of congenital origin, and to toxemia as in thyroid disease.

"To my mind it is better not to disqualify the registrant unless you are quite sure, but let the final decision be made the medical board of the camp. If the medical board is in touch with the plans of the War Department, doubtful heart cases will be assigned to duty in development battalions of the camps for special training and observation."

Conclusions.—Cardiac conditions to which little or no significance should be attached are:—

1. Extra systoles.

2. Sinus irregularities even when quite marked.

3. Irregularities of the pulse at the recruits age when not above 80 or 85 and when myocardial disease and heart block are excluded.

4. Systolic murmurs at apex or base if the heart is not enlarged and the response to exercise is normal.

5. Acceleration of the heart's action if hyperthyroidism, tuberculosis and other acute infections are excluded, if there is no enlargement of the heart and the response to exercise is normal.

6. Presystolic thrills, accentuated second sounds or reduplication of first or second sound at apex or base, unless a distinct presystolic murmur is present, or the heart is enlarged or the response to exercise is abnormal.

DISCUSSION.

Dr. A. K. Stone: I wasn't present and didn't hear the entire paper and I am going to give others the time to discuss.

Dr. J. H. Elliott: We would like to have some discussion. It is not so much the lesion as the work that the man can do; that is what we are interested in in the army, and the opinion of some of the men who have examined hearts would be of interest.

Dr. W. F. R. Phillips: I am not a clinician but occasionally I get an opportunity to see some clinical cases, and this last winter through the courtesy of a captain at Charleston who has charge of the aviation examinations and because of the interest I had taken in the anomalies of the heart, I was sent some men to look over who had been rejected by the examining board because of cardiac murmurs and who had been told they had heart disease. I had one interesting case, somewhat after the case Dr. Johnston quoted of Thayer, which presented a distinct murmur systolic, which, when the individual was standing in his normal attitude which was a slight stoop, could be heard, but disappeared entirely when he was told to throw his shoulders back. That was one of the murmurs which I think bore out my theory of the existence of a patent foramen ovale and I was quite confident that such a condition existed in his case. According to my ideas of the physics of the case when the body was bent forward the mediastinum would open and the atrium would relax and the foramen would be much larger than it would be when the individual was erect, which position would tend to close the opening of the foramen ovale. This young man, had an x-ray made and it showed his heart to be normal, he was later accepted and sent back to the aviation training camp.

Another thing: Dr. Johnston mentioned about diastolic sounds being always the cause of rejection. From my examinations in the dissecting room I doubt whether all diastolic murmurs should be rejected. I have seen pin-hole openings in the valves of both pulmonary and aortic arteries and I have seen cases where there were slits in the cusps and necessarily, regurgitation of the blood. I doubt that that regurgitation could take place without a murmur. These hearts were apparently good machines. I think we should all reflect whether we reject a man with murmurs.

Dr. G. E. Bushnell: Many of our examiners have not had much practical experience in cardio-vascular cases; their work has been to keep men out of the army, not see what they did in the army. It may be of interest to say a word as to the heart work in the Surgeon General's office. We find that the average doctor who has never paid much attention to heart disease and does not know modern views

goes on the principle that every abnormal sound means heart disease and rejection; a great deal of that is being done. The men in charge of the cardiac work in the Surgeon General's office are doing everything they can to raise the standard of the men who are examining, but the difficulty is that they have not got enough men. They have a course at Fort Oglethorpe and they send a number of men to the Rockefeller Institute. They do the best they can to examine registrants for the draft. We have a cardio-vascular specialist in each large camp, and as far as the allowance will go in the other places. We are not covering the army as much as we would like to. It is an opportunity for a man to get special experience in cardio-vascular work. There never again will be such a chance for a man to learn about heart disease as now because a great many experts are at work instructing and supervising in cardio-vascular conditions. And they have the same trouble with cardiac conditions as with tuberculosis. For some anything abnormal means active tuberculosis or incipient tuberculosis; many men are kept out of the service unnecessarily; it is the same thing with heart disease. It is commonly believed that the more expert a man is the more he will reject, whereas the contrary is the case. The experts will try to save men from being rejected, and they will save men in cardiac conditions just the same as they will save men from being rejected for lung conditions.

I wish to call attention to the fact that we have not got enough experts to go around and we can't cover the ground. That is true in cardio-vascular conditions as well as in tuberculosis, I regret to say.

Dr. E. O. Otis read a paper (from manuscript) on "The Soldier and Tuberculosis."

THE SOLDIER AND TUBERCULOSIS.

By EDWARD O. OTIS, M.D.,

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We are all familiar with the efforts that have been and are being made to eliminate tuberculosis from the Army before the soldiers are sent over-seas. The startling statements with regard to the extent of tuberculosis in the French Army, since shown to be greatly exaggerated, were an additional incentive to such efforts. Both phthisiologists of long experience and those recently trained by short intensive courses in the diagnosis of tuberculosis have been engaged in the work. The plan was as comprehensive as the army itself, namely, to examine every soldier in camp. Two classes of cases came under consideration: One, the open active cases which were to be rejected without question; and the other, the closed, latent, or arrested cases which were as a rule rejected, or referred for some service in the non-combatant force at home or abroad.

Excellent rules and formulæ have been given the examiners as to methods and procedure in the examinations, but it must be confessed that the judgment and experience of the seasoned diagnostician transcends any fixed rules, and he will make the diagnosis, when it can be made, in his own accustomed way better than when he is restricted or hampered by the methods of other men or by rules prepared by anybody else who may be his equal in skill and experience but who also arrives at his results in his own personal way.

Obviously but few of the evident open cases will be, or in my experience were found, for such are generally detected either by the exemption board if drafted men or by the examining surgeon if volunteers. Some slip by, however, either from the

carelessness or from the inadvertence of the examiner, as the following cases illustrate.

Quite recently a young man came to me whom I had seen eleven years previously and who then had unmistakable signs of tuberculosis. He now had active advanced disease, the left lung entirely involved and likewise the upper lobe or more of the right lung. He had so little free lung that any exertion caused dyspnoea. Moreover, he had a temperature of 101.2°. A short time previously upon April 5 of this year he was examined by the exemption board of his city and placed in Class A, "qualified for special and limited service." It is difficult to imagine what kind of "special service" a man with far advanced active tuberculosis could perform.

A young man twenty-five years old came to me in the uniform of one of the services, in which the physical examination is supposed to be particularly rigid. Five years previously I had been called into the country to see him and found him in the third stage of active pulmonary tuberculosis, with extensive infiltration and softening throughout the right lung and inactive disease in the left and with the usual symptoms of active tubercular infection. The examiner had evidently neglected to make him cough on auscultation; if he had done so, I am sure he would have detected râles in the left lung. On ordinary respiration, however, it was easy for one not especially experienced to overlook the condition, for the man in appearance was perfectly healthy and well developed.

On the other hand, a young man from Vermont came to me who had been anxious to enlist and who had been rejected by the Examining Surgeon of the Army on account of alleged tuberculosis. I was unable to find any physical evidence of the disease; the x-ray plate was negative, and he had a lung capacity of 250 cubic inches. I gave him a statement to this effect, and with this and his Roentgenray plate he appeared again for examination, and was again rejected with the statement that the lungs were suggestive of a pretubercular stage. The man

was somewhat underweight and rather poorly developed, it is true, but, in my opinion, there was no good evidence of tuberculosis. While we are taking every means of eliminating tuberculosis from the Army it would seem to be the part of wisdom to employ equally efficient means to prevent men from being rejected on account of tuberculosis without the clearest evidence of its existence.

As in civil life the border line cases or suspects present many difficulties and the decision for rejection or detention in the service must mainly be made upon the physical findings from the lack of time for observation and the rapidity with which the cases have to be determined. With the most experienced diagnosticians differences of opinion will, as they always have, occur. It is inevitable that some non-tuberculous men will be rejected and some tuberculous ones passed.

The question is how to reduce so far as may be the possibilities in the case to probabilities or certainties. Careful reëxaminations by several experts and a comparison of observations and opinions and the aid of the Roentgen ray may result in a definite decision. There is, and probably always will be, a difference of opinion as to the decisive value of Roentgen-ray revelations or lack of them. Many phthisiologists will, I think, agree with me that it is unsafe to base one's decision upon this evidence alone, and many will differ as to which set of observations should be given the preponderance when they differ,—those derived from the physical examination or those from the x-ray examination. For example—Capt. A. of the Medical Reserve Corps came to me for examination with the history that while on duty at one of the Southern camps he began to show signs of failing health, and on being examined by a physician of experience in tuberculosis he was declared to be tuberculous and sent home on a furlough. I examined him several times at intervals and always found persistent fine râles at the left supraspinous fossa. In consequence of this and from the previous history I advised his resignation from the service and accordingly

he went to Washington to accomplish it with a statement from me as to my diagnosis. This, however, was not regarded as authoritative, and he was sent to the Walter Reed Hospital for examination by an Army Surgeon of sanatorium experience. He was told that he had extensive disease in the left lung as well as some in the right one. Upon two separate occasions I had an x-ray taken by one of our most accomplished roentgenologists, now a major in the service and the head of one of the roentgenological army schools, who told me that in both instances the plates were negative and showed no evidence of tuberculosis. Which set of evidences shall we take, the physical findings, which, in my opinion and that of the two other examiners, indicated tuberculosis, or the evidence of the x-ray which showed no disease? In the one case the officer would be discharged, as he was, and in the other retained in the service.

Again a lieutenant in the M.R.C. came to me, somewhat perturbed, because, while in the roentgenological school for officers, he had an x-ray plate of his own chest taken which indicated some tuberculous infiltrations. I could detect no evidence of disease from the physical examination and evidently the examiner for entrance into the Army did not, and so far as the man knew he was in robust health. If the decision of his acceptance or rejection from the Army had depended solely upon the x-ray revelations he would have been rejected. I strongly favor, however, Dr. Brown's suggestion that roentgenograms be taken of at least 10,000 men of the National Army "for the benefit," as he says, "of future drafts and for the benefit of the whole civil population." A comparison of the physical signs, or lack of them, and the roentgenological findings of this large body of men would be most interesting and instructive. So far I am inclined to agree with Hawes* that "in adults the x-ray may give a certain amount of confirmatory evidence but never enough on which alone to base a diagnosis."

When one comes to the inactive, latent or arrested cases, the

* "Early Pulmonary Tuberculosis," New York, 1913.

"old tops," with no symptoms and only physical signs—and those perhaps indefinite—to indicate that a tuberculous infiltration or fibrosis exists, the difficulties both in diagnosis and decision are often as great as in the border-line cases. In the first place it is not always easy to determine the fact that "a very limited amount of tuberculosis" is present, "that is latent or arrested," as Biggs states it, from any evidence one can obtain from the physical examination. Equally skilled diagnosticians may differ as to the existence of modified respiration or deficient resonance. In the second place, it is a debatable question whether all cases of "a very limited amount of tuberculosis that is latent or arrested is almost certain to break down under the physical strain of military training and army life,"—to quote Biggs again. Some will and some will not, in my opinion, just as some will and some will not of those whose amount of tuberculosis is not much more than that of their childhood infection and which no human skill can detect. Herein comes the judgment and experience of the examiner to determine, so far as may be, which of the two contingencies is most likely to happen and to act accordingly. The family and previous history, the length of time the disease has been arrested, if it has ever been active, the present physical condition as to weight, strength, muscular development and nutrition, the way the soldier has performed his military duties up to the time of his examination,—are all more vital points in making the decision, it seems to me, than the physical findings alone. An old "very limited" fibroid condition of many years standing which has never shown any symptoms of breaking down under the ordinary conditions of civil life, or has in no way affected the general health, has a more than equal chance, I believe, of remaining firm under the extraordinary conditions of military life, and would appear to be a justifiable risk. It is a significant fact which I learned from Dr. Miller who has been studying the tuberculosis problem in France that the French think that mild cases of tuberculosis, whatever they mean by "mild cases," are improved in the tren-

ches and in war activities,—an opinion supposedly based on observation and quite contrary to that of Dr. Biggs quoted above.

On the other hand, a dubious family and personal history with a tendency to lowered resistance under slight or moderate provocation, indifferent assimilation, unsatisfactory development and failure to develop vigorous health under training, with the same amount of latent trouble, will indubitably break down under the continued strain of army life and would be an unjustifiable risk. To treat both cases alike because they both show the same physical signs or the same x-ray picture, and to reject both, would seem to be poor judgment on the part of the examiner and defraud the Army of some good men who would in all probability go through the ordeal without developing active disease. Of course it is obvious that the consequences of a wrong decision in these latent, arrested no-symptom cases both to the Army and to the individual are more serious than in civil life. With the soldier it is the question of the continuance or abandonment of his occupation,—that is, of his military life,—while with the civilian no such decision ordinarily has to be made, or, if it does, such serious possibilities are not involved as in the former case.

It is generally believed, and the evidence at hand seems to confirm this belief, that almost every adult has acquired sometime during his childhood a tuberculous infection, which has caused more or less deposition of tubercle in his glands or lungs. When such latent tuberculous infiltration is extensive enough to give definite physical signs, but with no symptoms, we are told that such latent disease should disqualify a man from service. On the assumption, to quote Biggs once more, that this inactive process "will almost certainly become active"—how do we know that the lesser infiltration or the deeply buried focus which we do not or cannot discover will not break down as well as the discoverable amount? Or that the discoverable amount will not remain latent and inactive under military life and conditions as well as the undiscoverable amount? We all know that a certain un-

known number of men who are passed as without discernible signs of tuberculosis will later develop the disease in the army; in this case it is the undiscoverable or undiscovered amount which has become active. It would be an interesting and instructive observation if some of these latent symptomless cases which could be discovered by physical signs or the x-ray should be permitted to enter the Army, and compare the results with those in whom no discoverable signs of latent tuberculosis were present. In other words how many greater infiltrations would break down and how many lesser ones.

After all, the "conclusion of the whole matter" in our present state of knowledge in regard to eliminating tuberculosis from the Army is to reject all obviously active cases, and, secondly, to reject or refer to the non-combatant force all latent inactive, arrested cases which one's experience and judgment decides would probably break down under active military life. When all this is done it is a fairly debatable question just how much it will lessen the incidence and development of tuberculosis in the Army, for the real test of the soldiers' ability to go through the strain of military service without developing the tuberculous infection or latent focus he has, or may have, into activity is not whether or not he has some discoverable lesion, the "very limited amount" of Biggs, but it is dependent upon that illusive and unknown cellular response to infection and to his hidden lesion under varying conditions of life which we call *resistance* and whether or not the barriers which shut in the tubercle will withstand the drive. It is Hindenberg versus the Allies.

Do what we will to exclude tuberculosis from the Army, it is, of course, inevitable, as I have said, that a certain percentage of the men while in France will develop the disease and in consequence will have to be removed from the active force and placed under treatment. Already government sanatoria have been planned, or existing ones taken over, for the care and treatment of each invalided soldier. Why not treat the curable cases in Europe where they are? In Switzerland or some favorable

climatic regions of France? Such a plan would enable the men to be placed under treatment almost at once and would avoid the long and weary journey over-seas with its incident risks. We all recognize the capital importance of beginning treatment at the earliest possible moment after active disease is discovered. Moreover, the expense of the long transportation would be saved and accommodations and treatment abroad would probably be not more expensive, if as much, than in this country. Furthermore, it is the desire of the Surgeon General's department, as reported by Dr. Pattison* that the returned tuberculous soldiers should give themselves entirely to the business of getting well, and consequently they should not be placed in sanatoria close to their homes on account of the distractions of visiting friends and relatives. This objection would, of course, be obviated if the treatment was conducted abroad. Of course, some men would prefer to return to America for treatment on account of personal considerations, but others, I believe, would be glad to embrace the exceptional opportunities that could be offered abroad. In France there are excellent climatic conditions for the curative treatment of pulmonary tuberculosis and abundant accommodations could be found in existing sanatoria and in the various health resorts now empty of guests. In France there are also many resorts in the French Alps and Pyrenees, in the Riviera, at Pau, Cauterets, and many others. They are but a comparatively few hours distant from the Western Front, and the American soldier unfortunate enough to develop tuberculosis could be under treatment in a favorable climate almost at once after the discovery of his disease. I am unaware that such a plan has been proposed, but it seems to me a reasonable one to be considered.

Dr. Jay Perkins read a paper (from manuscript) on "What shall be done with Tuberculous Soldiers?"

* "Following up Tuberculous Soldiers," by H. A. Pattison, Medical Field Secretary, National Association Bulletin of the National Association, March, 1918.

WHAT SHALL BE DONE WITH TUBERCULOUS SOLDIERS DISCOVERED—IN THE DRAFT, IN THE CANTONMENTS, OVERSEAS?

By JAY PERKINS, M.D.,

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This is a broad question and opens many lines of thought. What constitutes a tuberculous soldier? Is he a man who presents some of the physical signs found commonly in examining patients in a tuberculosis sanatorium or does he present some signs usually associated with old healed tuberculous lesions; or does an x-ray plate show shadows which on a hasty examination are interpreted as tuberculous, even though the man himself feels and appears perfectly well? Or is he a man who has tuberculosis as a disease and not merely as a past, doubtful present or a feared future infection? If real disease is present is it acute or chronic, open or closed, previously known or unknown, treated or untreated, curable, capable of improvement, already in a fairly stable arrested stage or far advanced and apparently "hopeless"?

I think we will all agree that the diagnosis of pulmonary tuberculosis either by physical examination or x-ray has not reached the stage of scientific accuracy and only those of large experience in examining lungs which are healthy and lungs diseased by reason of lesions other than tuberculosis, as well as lungs which are tuberculous, can make a reasonably accurate diagnosis in a considerable proportion of cases.

Our increase in knowledge concerning lung infections and lung conditions and the causes of clinical symptoms should make us careful in making positive diagnoses in many cases presenting signs or symptoms common in pulmonary tuberculosis. While I have not had the experience in x-ray work which

I have in clinical I have had enough to teach me the danger of having plates and especially single plates interpreted by one without extensive experience both in reading plates and examining chests clinically. Each examiner has no definite standards by which to be guided except his own and these must be obtained from his individual experience. I remember well the attempt of this association to adopt a scheme for recording examinations diagramatically. It was found that there was no agreement as to what certain terms meant, yet all were accustomed to hearing the same sounds. The uncertainties of an accurate diagnosis in the army work are also added to by the conditions under which many of the examinations are made.

For the proper handling of these cases it is evident that the first requisite is a correct diagnosis and before any radical measures are taken the diagnosis should be confirmed. The diagnosis being confirmed, the individual case must be considered. Was he rejected because of an old fibroid condition of many years standing, an arrested case in good physical condition and of no danger to others? If so, advice is all he needs. Is he a former sanatorium patient or one who has been educated as to tuberculosis and in whom the disease is now inactive? If so, he can continue to care for himself. Is there active disease, either acute or chronic? If so, he needs attention. What should be done for him depends on his personal condition, physical and financial, and whether the condition is discovered in the draft or while in the service and in line of duty.

Draft.—Now let us consider the cases as seen in the draft. My knowledge of the draft is from serving full time on one advisory board and part time on two others. We had sent to us from the local boards all men with any abnormal signs in the lungs. I did not keep any record of these cases until I was asked to write this paper and we had then been working for some time, but undoubtedly the general character of the cases was the same throughout. After the time I began keeping a record I have found 49 cases giving signs of tuberculosis. Of these, 19 gave

fibroid changes without râles, 15 gave fibroid cases with râles and 15 were acute or chronic cases with marked activity. Now what can be done with these cases?

The cases with fibroid changes but without signs or symptoms of activity are usually already at some occupation in which they are doing fairly well. Some of them are clinically well and others are below par in general condition, but I do not see how much can be done to improve them as a class and I should say, let them alone.

At the other extreme, the active cases need treatment. Hospital treatment is what they should have but most persons of this class refuse this unless they have no homes or means of support and we can hardly compel them to go to institutions unless they are so careless and obstinate in their home life as to make themselves markedly dangerous to others. Part of the fault in reference to these cases refusing to go to hospitals rests on the hospital management. Hospitals for advanced and chronic tuberculous patients are not sanatoriums. Their function is not to heal; it is to protect the public and to make homes for these people. They should be run for the benefit of the patients and not for the purpose of carrying out a definite set of rules or to enforce discipline. These patients can not be cured, but they can be made more comfortable and reasonably contented. Even if they are improved, except in occasional cases, that improvement is but temporary. To get well of advanced tuberculosis requires years of inactive life in good surroundings and none but the wealthy can secure this, and the wealthy we do not have to consider here,—they can take care of themselves. Those of the poorer classes who go to a sanatorium, even if they get better are not cured; they go back to their old surroundings, after a time break down again and live longer than they would had they not had the treatment, but are so much the longer a source of danger to the public, a burden to themselves, their families or charity and no economical advantage has been obtained nor has the sum of human happiness been increased.

I say even if they do get better, because many of them really do not get better, even under sanatorium treatment.

The mental state of the patient is of the utmost importance in recovering from tuberculosis and after nearly fifteen years' experience in a hospital which takes chiefly advanced cases I am firmly convinced that it is a mistake to enforce upon advanced tuberculous patients the same discipline and treatment which is proper and advantageous to early cases. During my early years in connection with this institution I tried, while on the service, to carry out sanatorium methods, but now for several years I have had full charge of the medical work and in full coöperation with the Sisters who run the hospital we have made it primarily a home for the patients. From the disciplinary side we have run it so as to prevent annoyances, as far as possible, to the other patients and to have general good behavior. Under this method comparatively few patients are discharged as a disciplinary measure and not many leave because of dissatisfaction. From the standpoint of the ordinary hospital ideal I am not proud of my work; from my ideal of protecting the public and making the last days of these individuals comfortable and happy, as far as possible, I am pleased with the reward for the time spent. I have learned that the relaxed discipline and nearer approach to home life has in many cases done more to improve the physical condition of the patients than more strict sanatorium life, even though that was not the object of the change.

We have now to consider the large class which is between these two extremes: the men with fibroid changes, the arrested and quiescent cases with considerable involvement. The proper handling of these cases is a problem of the greatest magnitude. The advice used to be "Get some out-of-doors work." This was easy to say and sounded well. The results, however, were quite different from the saying. I have seen patients try to carry out this advice in different ways, but have rarely seen a success. I have seen them try going onto a small farm, but

farming, even on a small scale, means hard work and they are not able to do it. Chicken farming I heard considerable about at one time and have seen it tried, but it was unsatisfactory. I have seen these men go onto laundry and grocery wagons, but between the stair climbing, exposure to storms and cold and alternating between warm rooms and out of doors it was very unsuitable. For quite a number of years I have advised a return to the old occupation unless it was very unsuitable or something better was in sight for the individual. Taking up a new work usually means a greater mental strain and lower wages which adds to the mental strain. The old work, with its familiarity and better pay, makes life easier and home conditions better. If the mind is easy, home conditions good and a proper life carried on outside of work hours, they can frequently stand considerable work, if they do not work too many hours in succession. We now hear a good deal about establishing farming colonies. The Red Triangle is trying this method in England. I have an open mind on the subject, but I know what farm life is and unless some new way can be found for carrying on farm work I do not see how a satisfactory living can be made by these men on a farm without subjecting them to greater strain than they can bear. In the planting and harvesting season, long, hard days are necessary if profit is to come from the occupation, and men will not be satisfied with any occupation which does not yield a profit. Here, also, is the element that the work is new and unusual as work. Also, to be profitable, farming must be carried on scientifically and scientific farming means study and practice or long practice under a good farmer. There is a great difference between owning a large farm and hiring the hard work done, as so many of our business men do without regard to the profit and loss account, or having a small garden to raise a few vegetables for the table, and going into it as a business and means of livelihood. I can but be very sceptical as to the success of this scheme.

What, then, can be done with these men to lighten the bur-

den of their existence? Many of them are not able to do a full day's work at anything with regularity and employers of labor are not philanthropists, at least when it comes to their business. All men are essentially selfish and while by sufficient missionary work and newspaper propaganda they can be brought to a state of mind such that they will forego meat and drink to a certain extent, eat war bread and give some of their tobacco to the soldiers, when it comes to employing any but those who will accomplish the most for the profits of their business it is more than human nature will stand.

Any scheme for making these men self supporting and reasonably contented must have at its head an enthusiast and one skilled in the work at hand. Our fellow member, Dr. Phillip King Brown, has obtained good results in California using pottery as a medium. There are various forms of light indoor work which can be developed;—"handicraft" work in general, light cabinet work and one of the leading industries of Providence and the Attleboros, cheap jewelry manufacture. Could some of these industries be organized so that the individual could have the profits of his labor, the organization getting only interest on the investment, the men paid for what they do and being allowed to work only as many hours as they are able and their home life being properly guided I believe we would have a better solution of the problem than any now in practice. The success of even this scheme would depend upon the enthusiasm, personality and ability of the guiding mind. Wages in most industries are now high and help hard to get. With immigration shut off for so many years the same conditions will probably hold for some time to come, which makes this a favorable time for such a venture. In "handicraft" work success might come by selling the products to a special list of customers, but in the regular industries one would have to meet regular market conditions and compete with the regular trade.

We have in Providence a school of design which teaches various things which could be done by the more able or the less

disabled of this class of young men and a special school could be established which, while not giving a full course, could give enough in special branches to enable the student to earn a living and then if he recovers to have a good occupation for life.

In the Cantonments.—Here comes the question as to whether the disease was acquired in line of duty. If it was not acquired in line of duty there should be some oversight of the man, some one to advise him and to refer him to his home antituberculosis society. A Red Cross worker would be my preference. During my three months' experience on a tuberculosis examining board most of the men found afflicted were taken by surprise at the finding and did not know what to say or do. There was frequently considerable delay in getting the papers through and the man wandered around like a "lost soul in Hades," while waiting for his discharge. Some one to advise and instruct him and help hurry his papers along would have been of great help in many ways.

If he was considered to have acquired the disease in line of duty he had his choice of a discharge or a government sanatorium. Most of the men took their discharge.

Overseas.—One would naturally think of those men sent home from France as having tuberculosis as having the disease in an active stage. The experience in the French army is that of those sent back from the front as having tuberculosis the diagnosis was confirmed in about twenty per cent. In those sent back from our own army the diagnosis has not thus far been confirmed in a very much larger per cent. The first thing here, therefore, is to confirm the diagnosis and then to provide sanatorium treatment for them. All of these men are "in line of duty" and the government must care for them unless they ask for their discharge. They should be encouraged to remain under government care and in the sanatoria established for their care. Many will doubtless return home and the sanatoria, hospitals and antituberculosis societies need to be prepared to handle them. The Red Cross is already alert and educating other organizations as to the care of their dependents.

The hospital and sanatorium care of these patients will doubtless be in excellent hands and will differ in no way from similar patients from the ordinary civil life. Here will be an excellent chance to educate those who recover so that they may afterwards be self supporting, by teaching them some trade which is within their physical limitation.

During the past twenty-five years many things have been taught and advocated in reference to the medical and sociological aspects of tuberculosis which in the light of our present knowledge we know were only half truths. The present is a critical time for the nation in reference to tuberculosis work, a time when science and common sense need to be used to the utmost, that the work may be placed on a more enduring foundation and a new start made in the antituberculosis campaign. Never before have so many cases been in hand at one time; never before has such a thorough examination been made of any one class as is now being made of our young men. The country is fortunate in having at the head of this work on the part of the government a man of skill and experience with the disease tuberculosis. Even though his ideas of the attitude of the government towards many of the doubtful cases does not agree with the ideas of many men in tuberculosis work, the government should have our full support in aiding him, at least until experience has shown whether his optimism is justified or not. When the war is over we will have data of great value for future guidance. Let us help to make this data as valuable as possible.

These two papers were discussed together.

DISCUSSION.

Dr. J. H. Pratt opened the discussion, reading from manuscript.

Dr. W. C. Klotz: In connection with the problem of the tuberculous soldier I would like to call attention to our experience on the Pacific coast where many of the soldiers discharged for tuberculosis have joined the ranks of the migratory tuberculous. We have found that in the case of soldiers from Camp Kearney, and this resulted in the lack of discipline and demoralization of the men. We draw rules

at the sanatorium and yet they would not stay more than two weeks, and instead of being amenable to sanatorium discipline, they were just the other way. As soon as they were discharged they wanted to go their own way, and they could not obtain work because their discharge papers showed that they had tuberculosis, and employers wouldn't take them in California, and I think I should make a suggestion that the government should take care of these men and keep them under military discipline.

Dr. G. E. Bushnell: Dr. Otis said that rules would hamper: I should be glad to reply. I have the impression that the majority of examiners found rules very useful, and in fact some of them went to work and made additional rules. It has been a common experience for examiners to come in and give me sets of rules, because they thought it was necessary to standardize the matter still further than I had attempted.

The indication as to discharge or rejection for arrested lesions has been the great stumbling block and difficulty. The rules originally adopted were referred to some of the most eminent internists in the United States and were approved by them. The most vexed question was what was the size of the arrested lesion that should lead to rejection. As originally written, any lesion of considerable size would be cause for rejection. "Considerable" is not a good term, but we couldn't think of anything better. Some of the examiners adopted the rule that a lesion that went down to the third rib was to be a cause for rejection, and it has been stated that that was a direction from the Surgeon General's office; no such direction has been given. My view is that the intensity is as important as the extent. A rather extensive lesion that has led to fibrous tissue is less important than a small active focus.

No doubt some were wrongfully rejected; it is difficult to determine from our office what has been done in that direction. It will be interesting to see how many men will prove to be well who have been rejected. It is probable also that some examining boards have been too liberal and have accepted men whom I wouldn't accept. I should be glad to have Dr. Perkins say a word about the directions and whether they have been lived up to. It is an extremely difficult matter, as we all know, to decide as to the border-line cases. There are cases which men in this room would interpret in a great many ways, and they might occassionally interpret the same case differently a few weeks later.

Now as to how it turns out in practice: A great many men occupied with tuberculous work in the army have told me that it did not come out the way they thought. The man who looked not very strong, who had obsolete lesions was not the man that broke down. The men that broke down were often the athletic men. I have had a great many

tell me that they could not predict what would happen. Of course, I admit that a man with a delicate physique might break down without having tuberculosis, but under ordinary conditions it is hard to predict who is going to break down; in other words, there is an unavoidable percentage of tuberculosis. It is not a case of muscle but of resistance. A good many strong men are more dissipated and do not take any care of themselves and they will break down more acutely than the man who has enough sense to take care of himself and use precautions.

The question of who should be disqualified: I understood Dr. Otis to say that all old cases of tuberculosis should be rejected. That is impossible There are many old cases that are interpreted by some as incipient cases and by some as normal. There are all shades of opinion. If we should say that all signs of tuberculosis should lead to rejection we would have no army at all, if some men did the examining. We must remember that in giving instructions we are not giving our instructions to the members of the Climatological Society, experts, who can be trusted to do what we wish, but we are giving instructions to physicians many of whom we know nothing about and we have to be specific, otherwise there would be no agreement as to procedure.

In regard to the treatment of tuberculosis from over-seas: Dr. Otis spoke about the advantage of sanatoria over there in Switzerland. I wrote to General Bradley and told him that my view was that tuberculous cases as soon as diagnosed, should be sent back to this country, because we could not rely upon them in military service, and it would be better to get them out of the way. He wrote back to me and told me he agreed with me. I don't know what his successor thinks. Major Webb, a member of this Society, has recently gone over to Europe to look into the tuberculosis situation there, and I think from the letter he wrote that he agrees with that view. He thinks that the conditions over here are better and that the Rocky Mountain climate is better than that of Switzerland. I will read a paper later on the provisions for tuberculosis, so I will not go into it now.

There is one point of interest and that is of the men sent back with the diagnosis of tuberculosis only one third of them have active tuberculosis, showing a great need of a sifting center such as they have already adopted for the Italian army and the French army. Dr. Webb is going to initiate a center of that kind in order to make sure what the diagnosis is before returning the patient to this country. Of course there has never been a time in the history of this generation when it was so difficult to diagnose tuberculosis as it is today on account of the widespread streptococcus infections of the lungs, hence the rule has been adopted that no man will be discharged for tuberculosis unless he has a positive sputum. That rule may be modified, but it is the only way to prevent unnecessary discharges.

I want to say something about Dr. Pratt's paper in regard to scales: The German army has adopted the plan of weighing all recruits,

not only the men suspected of tuberculosis but all men, and they are weighed every week, and those who are losing weight under military life are given examinations for tuberculosis. That is an excellent rule, and I will recommend that it be adopted in our army, as it is an automatic way of detecting suspicious cases.

Dr. J. H. Elliott: I am sure the Society is indebted to Colonel Bushnell for his talk. Dr. Bushnell has indicated that any minute, letter from Dr. Otis or Dr. Perkins will be given consideration.

Meeting adjourned.

A SHORT BIBLIOGRAPHY OF UNITED STATES CLIMATOLOGY.

By ROBERT DeC. WARD,

Professor of Climatology, Harvard University.

The Basis of Climatological Study.

Climatology deals with the same group of atmospheric conditions, or *elements*, as those with which meteorology is concerned. The characteristics of each of these *climatic elements* are set forth, and a full description of a climate is given, by means of a standard series of numerical values, based on systematic and long-continued meteorological records, carefully corrected, compared and summarized by well-known methods, and tabulated in standard form.

Early Individual Observations in the United States.

Every person who carefully records an extended series of accurate meteorological observations therefore potentially contributes to a better knowledge of the climatology of his country. American climatology really owes its beginnings to the pioneers who, alone and with inadequate facilities and equipment, faithfully kept their daily records in the earlier years of the country's history. Names which may well be remembered are those of Rev. John Campanius, who, in 1644–45, at the Swedes' Fort, near Wilmington, Del., kept what is believed to have been the first regular record of the weather on the North American continent; of Hon. Paul Dudley, Chief Justice of Massachusetts, who kept a meteorological record at Boston, Mass., in 1729–30; of Dr. John Lining, who began thermometer records at Charleston, S. C., in 1730, and maintained a more extended series of observations from 1738 to 1750; of Professor John Winthrop, of Harvard College, who, from 1772 to 1778, kept

regular weather records at Cambridge, Mass.[1] It is not unworthy of mention that Thomas Jefferson, at Monticello, Va., and James Madison, at Williamsburg, Va., "maintained a series of contemporaneous observations" during the period 1772–1777, and "showed that the climatic peculiarities of those two places harmonize completely.[2] And Benjamin Franklin, also, scientifically best known because of his famous kite experiment, kept records of weather and of water temperatures during his homeward voyage from England.

The Beginnings of Organized Meteorological Observations.

The early pioneers were enthusiastic observers, and did painstaking work, but their efforts were scattered and could not contribute to the development of scientific climatology. Coöperation and coördination of effort were essential, and these involved organization, and a central control. Thus it gradually came about that the local observers became part of a system, and uniformity of work, on an increasing scale, replaced the more or less haphazard and irregular observations of the earlier period. The first series of meteorological observations organized under National control was inaugurated by the Medical Department of the Army in 1819. By an order of the Surgeon-General, dated July, 1816, it became the duty of each hospital surgeon "to keep a diary of the weather," and these "diaries" have been continued at many Army medical posts ever since, although the records have, since 1890, been turned over to the Weather Bureau. "Meteorological registers," embodying the results of these observations, were issued at various times, and in 1860 the Surgeon-General published a report which brought the results down to date, thus covering about forty years.[3] In 1872 a volume entitled "The Climate of the United States and its Endemic Influences," by Dr. Samuel Forry, was based upon the data collected by the Army Medical Department.

The Smithsonian Institution, under its first secretary, Pro-

fessor Joseph Henry, inaugurated a fairly extended system of observations in 1849. This was continued for 25 years, when (in 1874) the meteorological work of the Institution was formally transferred to the War Department.[4] The number of observers who coöperated varied from 100 to about 350. The data thus collected were utilized as the basis of several important studies, those of most direct climatological interest being two monographs by Charles A. Schott, both of which appeared in the *Smithsonian Contributions to Knowledge*.[5]

An early volume, which may well be called "a real treasure-house" of the early meteorological observations made before about 1850, is Lorin Blodget's "Climatology of the United States."[6] Out of the confused mass of scattering observations which had been accumulating from different sources at the Smithsonian Institution; at the office of the Surgeon-General, and from "gentlemen at distant points distributed over the country." Blodget brought, so far as was then possible, both order and accuracy. This book is still a valuable summary of many of the outstanding facts of American climates.

After the Medical Department of the Army had begun its meteorological work, and before the Smithsonian Institution had inaugurated its system of observations, the regents of the University of New York had established a local series of meteorological observations in that State (1826–1850), and the Franklin Institute and American Philosophical Society of Philadelphia, with the aid of the State of Pennsylvania, had coöperated in establishing a number of meteorological stations in Pennsylvania (1837). These were the beginnings of local state weather services, all of which later became absorbed in the federal weather service.[7]

The National Weather Service.

The actual establishment of a general National Weather Service came in 1870, in a joint Resolution of Congress (approved February 9, 1870) providing for the taking of meteorological observations at military posts and at other points, and for giving

notice of the approach and force of storms. This important undertaking was put in charge of the Chief Signal Officer of the Army, and there remained until July 1, 1890, when it was transferred to the Weather Bureau of the Department of Agriculture.[8]

The Increasing Emphasis upon Climatology.

In the early days of the Signal Service emphasis was naturally chiefly laid upon the immediate problems connected with storm warnings and weather forecasting. This was strictly meteorological work. Gradually, however, as meteorological data began to accumulate, and as agricultural interests became more important, more and more emphasis was laid upon the climatological applications of the national weather service work. The voluntary observers in the different States and Territories were more systematically organized; a comprehensive and uniform scheme for taking observations was gradually developed, and regular climatological summaries were published. Thus, after many decades of the slow accumulation of meteorological records, the stage has been reached when the essential facts concerning the climatology of the United States, although not yet ascertained as completely and as accurately as is desirable, or as will eventually be possible, can nevertheless be presented in such a way as to meet all ordinary requirements. It is only in the last two or three decades that the observers have been fairly well distributed over the country; that their number has been reasonably adequate, and that their observations have been made on a comprehensive and uniform plan. Hence, the period covered by the most complete and reliable climatological records is, in most cases, a relatively short one.

The Available Standard Publications.

The standard general descriptive and statistical volume is at present Professor A. J. Henry's "Climatology of the United States."[9] The first 84 pages deal with the larger features of the

climates of the United States. For each State there is also given a brief discussion of its essential climatic characteristics, followed by a summary of the more important climatic data for representative stations. The latter are grouped by counties, and are alphabetically arranged in the index, so that reference is easy. The statistics as a rule cover the years 1870–1903, but in a good many cases the period is shorter.*

Another valuable body of statistical data is contained in the "Summaries of Climatological Data by Sections."[10] A very large mass of numerical material, especially in regard to rainfall, is here brought together in a convenient form for ready reference, and many of the ordinary questions concerning climatic conditions in the United States which are daily asked by hundreds of persons here find a ready answer. The country is divided into 106 "climatological sections." For each section there is a well-considered brief summary of the topographic and the climatic features. Then follows a compact brief digest of the most essential climatological material which has accumulated during the last half century, the precipitation data being given in full, not alone by averages for the whole period, but, for the most important data, by individual months and years as well. Monthly and annual amounts of precipitation; averages and extremes of temperature; frost data; wind velocity and direction, and other information, are presented for each station which has a record long enough to give a fairly accurate picture of the actual climatic conditions. For each section there is a full page of diagrams showing the comparative monthly distribution of precipitation at selected stations. These diagrams illustrate very clearly the occurrence of wet and dry seasons, and the local variations in rainfall due to topography and general environment. One of the most useful features is a contoured topographic map of each section, showing the location of the stations and of the principal rivers. The period covered by the data varies. For most

* The data are, therefore, not homogeneous, and are not reduced to the same period. The temperatures are given in whole degrees (F.) only.

sections the last year in the tables is 1908. In some cases it is later (1909 or 1910). Reprints, issued from time to time for the various sections, bring the observations down to later dates. Further, the *Annual Reports of the Chief of the Weather Bureau* contain the continuations of the data for Weather Bureau Stations.*

Detailed climatological data, covering all the stations maintained by volunteer coöperative observers as well as the regular Weather Bureau stations, are collected and published in the monthly and annual reports of "Climatological Data," issued at the so-called Section Centers, each Section as a rule corresponding to a State.[11] Further, the *Monthly Weather Review* contains a summary of local weather conditions; the usual standard climatological data for regular Weather Bureau stations; tables of accumulated and excessive precipitation, and a series of charts showing the departure of the mean monthly temperature from the normal; the total monthly precipitation; the percentage of clear sky; the sea-level isobars and isotherms; the total snowfall (in winter months), etc.

The *Review* contains many more or less important papers on local and general climatology. Supplements to the *Review* are issued from time to time, containing more extended discussions of various matters of meteorological or climatological importance. Among these, reference may here be made to a monograph by P.C. Day on relative humidity.[13]

In addition to the foregoing standard statistical publications, there is a large and rapidly increasing number of reports, of varying degrees of importance, on the climates of different states or cities. Most of these discussions have appeared in the publications of State or of local scientific and other organizations, and are, therefore, widely scattered. No complete list of these papers is available. Anyone who wishes to secure information in regard to the published discussions on any particular State or

* This is a Congressional document. It may usually be obtained by application to members of Congress.

district should write to the Chief of the Weather Bureau (Washington, D.C.), or to the officials in charge of the various Section Centers.* Among the most important of these publications the volumes of Professor Oliver L. Fassig, on the climate and weather of Baltimore, and of Professor H. J. Cox and Mr. J. H. Armington, on the weather and climate of Chicago, deserve special mention because of their completeness.[14]

Many publications, both official and other, contain charts. A special set of climatic charts is issued by the Weather Bureau,[15] and the forthcoming meteorological section of the new "Atlas of American Agriculture" will contain the latest and best statistical and cartographic information on the subjects with which it deals. An advance sheet of a new mean annual rainfall map from this new "Atlas" has been published.[16]

A valuable series of papers on various phases of medical climatology has appeared in the *Transactions* of the American Climatological (now American Climatological and Clinical) Association. On the general subject of medical climatology in the United States reference should be made to an important treatise by Dr. Guy Hinsdale.[17]

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9. Bulletin Q, U. S. Weather Bureau, 4to, Washington, D. C., 1906, pp. 1012, charts 32, figs. 7.

10. Bulletin W, U. S. Weather Bureau, 4to, Washington, D. C., 1912. 2 vols. The first volume covers the country west of the Mississippi; the second, contains the data for stations east of the Mississippi. The several sections of Bulletin W are revised as promptly as possible, and some ten or fifteen of the numbers have already been reprinted. The publication is not listed among those for sale but copies may be obtained, unbound, from the Superintendent of Documents at the following prices; 5 cents for any individual section, 10 cents for three separate sections, and 3 dollars for the entire set.

11. "Climatological Data." A monthly volume, in one cover, containing data for all the sections except the Hawaiian Islands and Porto Rico, is issued at 35 cents a copy. Subscription for 12 monthly copies and the annual summary, $4.00. Reprints for single sections, 5 cents each. To be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

12. *Monthly Weather Review.* Copies may be obtained from the Superintendent of Documents, as above, at 25 cents each. The subscription price per volume is $2.50.

The *Monthly Weather Review* up to July, 1909, partook of the nature

of a weather magazine and climatological review, giving details of weather conditions for each month, and each number contained articles of permanent interest on practical and scientific lines. From July, 1909, to December, 1913, the *Review* was made up of the local data of twelve climatological sections of the country. Since January, 1914, all local climatological tables have been transferred to the monthly issues of *Climatological Data*. The *Monthly Weather Review* since January, 1914, comprises the following: (1) Aerology, (2) General meteorology, (3) Forecasts and general conditions of atmosphere, (4) Rivers and floods, (5) Bibliography, (6) Weather of month.

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BLOOD LETTING.

By WM. DUFFIELD ROBINSON.

History.

Hippocrates, 460 B.C. Galen, 130 to 200 A.D. Sydenham, 1624 to 1689 A.D.

Cullen of Great Britain 1757 and Gregory of Edinburg of the same date lived when blood letting was at its greatest height. France, Italy and most other nations used it at this time very generally. In Italy frequent and excessive amounts were taken. One case reported was that of a boy of 19 being bled of 222 ounces in 17 successive bleedings.

In the earlier part of the nineteenth century many doctors bled gratis on Sunday morning. Often more than one hundred patients waited in turn. One doctor ligated the arm, another opened the vein, a third completed the operation and another dressed the wound.

The first strong objection to the practise was made in 1856 by Hughes Bennett. Disuse gradually developed from that date, but of late its proper place as a therapeutic agent of great value is being firmly established. It gives relief immediately, and often saves life when from any cause all or a part of the vein side of the circulatory system is suddenly or abnormally over engorged and distended. This applies especially to vessels which carry vein blood to the heart and to the right side of the heart.

When the heart is embarrassed by right side dilation and the veins contain undue proportion of blood it is the veins and not the heart or left side of the heart that are to be avenues of relief. Dilitation, gradually produced, brings about a paralysis of power of veins to contract against contents in effort to push on the contained blood. When the vein system is mechanically partially emptied, the encircling and longitudinal muscle fibers of the

veins soon regain the power of contracting and so moving on the contained blood.

One or more parts of the body may have blood engorgement in the capillaries or small veins of both sides, arterial and venous. Infection is the usual cause. Trauma in some instances responsible by reason of physical injury to the vessels causing local reduction in their calibre.

In infection the local demand for blood in excess of the normal amount, to defend against the invading organisms, may be such as to send blood in such quantity as to engorge the smaller vessels so intensely as to temporarily paralyze their contracting power. If coagulation occurs within the vessels in stasis from such cause nutrition and defense against growth, and poisons of microörganisms result. This means necrosis, that is chemical break down of the normal tissues, with no immediate means of replacement. Ulceration is the name given. The treatment requires the getting in a supply of good arterial blood, and holding the chemical activity destroying the tissue during the reëstablishment of normal or partial circulation.

The first result is secured by removing the obstruction, that is by getting the vein side of the capillaries empty and motor power reëstablished in the veins. Blood letting by a nearby local bisecting of the veins instrumentally in some parts, and by bite and suction of leeches in others is a means to be employed.

Cold is used to inhibit the multiplication of the pathogenic germ life and the resulting local destructive chemical action.

Great care and judgment, the outcome of much experience must direct the use of cold or it will prove a two-edged sword in action. Persistent cold applied to a part is a devitalizing agent. The alternating use of heat to dilate the capillaries, contracted by the cold and so aid in getting arterial blood in is usually most essential.

The gain from the aid to blood flow which is much more quickly accomplished far outweighs any serious increased activity of germ growth and chemical destruction of tissue. It may be

compared to a gain of ten by cost of a loss of two. Again too, the frequent use of heat prevents the coagulation of blood within the capillaries which continuous use of cold causes. Such coagulation is of course a serious mechanical obstruction to reëstablishing blood circulation on which cure alone can depend. The capillaries solidified by contents being coagulated usually break down and circulation is only reëstablished by the growth of new parallelling capillaries.

Speaking more directly of our subject it may be stated that the purpose of blood letting is to correct unbalanced circulation. Its results are to reduce general or local excess pressure within the vessels, and to remove a portion of the poison present in the blood by reason of infection, or from the failure of function, as a result of functional or structural disease of some organ such as the kidneys or the liver.

Acute infection of an organ as of the lungs in pneumonia or functional fault as of the kidneys in diabetes may cause the blood to be dangerously laden with microörganisms and their products or products of metabolic faults as sugar and acetone. Blood letting reduces the percentage content of these poisons by removing part of the whole content with the blood taken, the volume of blood soon being made up by the asinosis of diluting fluids from the tissues.

Blood letting is also indicated when there is too much blood in both sides of the circulation, possibly in proper balance. Bleeding here may mean prevention of injury to vessels though normal, from persistent excess of pressure from within. A normal condition having secured through bleeding, it may be maintained by dietetic, sanitary, hygienic and possibly medicinal means.

Bleeding from a point distant from the point of local excess pressure, or degenerated vessel part is not easily understood, but in some instances seems to be well proven. Hæmorrhoidal bleeding seems to most quickly relieve cerebral hyperæmia, cord hyperæmia, blood spitting without organic cause, or in tuberculosis to stop lung bleeding particularly in mitral disease. An

effect similar to that produced by hæmorrhoidal bleeding is produced by leeching in the neighborhood of the anus.

Wet cupping may be mentioned as a method of locally extracting blood. In the present day it is rarely used but it is not without merit. For cerebral and cerebellar congestion, for pleurisy and various other local congestions wet cupping is excellent.

In mentioning various diseases and conditions in which blood letting has proven therapeutically effective, I have omitted discussing them respectively, first to shorten this paper and secondly to bring out full discussion.

Blood letting has proven beneficial in puerpal eclampsia, pulmonary hemorrhage, pulmonary edema, cardiac dyspnea, spasmodic asthma, irregular menstruation accompanied by magrine, cerebral apoplexy, croupous pneumonia, emphysema, hyperemia of lungs pleuritis, congestion of the brain, congestion of the liver, aortic aneurism, cholorosis, true plethora, threatened cerebral hemorrhage, high blood pressure, arterio-sclerosis, nephritis acute and chronic pulmonary ædema, gas poisoning, acetonuria, acidosism illuminating and other gas inhalation poisoning, various ulcerations including those of eyes and legs, broken cardiac compensation, many forms of local inflammations, and blood intoxication.

The amount of blood to be let may range from part of a drop in bisecting aneurismal capillaries in the eye to a quart at a time, repitition being according to indications.

Methods.

Cross scarification by the many bladed spring lance, and rarified air suction under antiseptic precautions.

Leeches.—Artificial leeches are like to cause local ulceration, unless great care is taken. Leeches draw about an half ounce of blood each. The clean surface has presented to it from a small glass the leech, by means of so manipulating the glass as to have the leech crawl to touch the part. The leech may be induced to take hold by having the surface smeared with a little blood or sweetened milk.

Venesection or Phelebotomy.—The median cephalic is farther from artery than the median basilic. These are most used but any of sufficient size and where back pressure may be readily induced will do.

A sitting or semi-reclining position is usually used, but I much prefer to have the patient reclining on a bed or couch. By this means sudden faintness or convulsion can nearly always be avoided.

The most modern methods make quite an operation of blood letting, by making a skin incision an inch or more in length, draining out the vein raising it on a probe or grooved director, ligating and incising. At end of bleeding the ligature is removed, the skin stitched and surgically dressed.

I have done many venesections in all sort of subjects, from the very thin with veins in easy reach to the very adipose with veins deeply buried but I have never made such incisions and I have never had any ill results. Rarely do I incise the skin for more than a quarter of an inch.

The incision should be at an angle to the course of the vein so as to cut both the circular and longitudinal muscular fibers. After removing constrictive bandage from above the cut vein I again mop with tincture of iodine and bind on the cut a small pad of gauze wet in 75 per cent. alcohol, kept in place with six inch long, one inch wide crosses of adhesive plaster.

I will close with reference to a mimic or temporary blood letting from a part by draining the blood in part in other parts of the body. The torso and its contents and the head may be so relieved of excess of blood by ligating tightly the limbs and arms as closely to the trunk as may be possible. It is wonderful how much blood may thus be collected and held from entrance into the general circulation for a time. This process may be used in actual or threatened cerebral apoplexy, in lung hemorrhage or bleeding from wounds. The method suggest a variety of promising possibilities by causing temporary depletion of parts of the body.

TRANSACTIONS

OF THE

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FOR THE YEAR 1919

VOLUME XXXV

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1919

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A. L. Loomis	1884–5
William Pepper	1886
Frank Donaldson	1887
A. L. Loomis	1888
V. Y. Bowditch	1889
Charles Denison	1890
F. I. Knight	1891
W. E. Ford	1892
R. G. Curtin	1893
A. H. Smith	1894
S. E. Solly	1895
J. B. Walker	1896
E. Fletcher Ingals	1897
E. O. Otis	1898
Beverley Robinson	1899
Abraham Jacobi	1900
Robert H. Babcock	1901
Samuel A. Fisk	1902
Norman Bridge	1903
James C. Wilson	1904
W. F. R. Phillips	1905
E. L. Shurly	1906
Thomas Darlington	1907
Thomas D. Coleman	1908
Charles E. Quimby	1909
Edward R. Baldwin	1910
John Winters Brannan	1911
Alexander D. Blackader	1912

Name	Year
Charles L. Minor	1913
James M. Anders	1914
Henry Sewall	1915
James Alexander Miller	1916
Judson Daland	1917
Jabez H. Elliott	1918
Guy Hinsdale	1919
Lawrason Brown	1920

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Frank Donaldson, Beverley Robinson	1886
V. Y. Bowditch, R. G. Curtin	1887
A. Y. P. Garnett, J. T. Whittaker	1888
J. R. Leaming, E. T. Bruen	1889
A. L. Gihon, H. B. Baker	1890
E. L. Trudeau, T. S. Hopkins	1891
E. Fletcher Ingals, Beverley Robinson	1892
A. H. Smith, E. O. Otis	1893
I. Hull Platt, E. L. Trudeau	1894
John H. Musser, G. R. Butler	1895
Charles E. Quimby, James A. Hart	1896
S. A. Fisk, John C. Munro	1897
Beverley Robinson, C. F. McGahan	1898
James A. Hart, R. C. Newton	1899
R. H. Babcock, J. W. Brannan	1900
Albert C. Peale, S. W. Langmaid	1901
Norman Bridge, W. F. R. Phillips	1902
James C. Wilson, H. S. Orme	1903
Thomas Darlington, Thomas D. Coleman	1904
S. G. Bonney, S. D. Risley	1905
A. D. Blackader, Henry Sewall	1906
Frank Fremont-Smith, C. L. Minor	1907
Judson Daland, Charles Fox Gardiner	1908

E. R. Baldwin, C. E. Edson 1909
James M. Anders, H. Longstreet Taylor 1910
Will Howard Swan, John H. Lowman 1911
Herbert Maxon King, Carroll E. Edson 1912
James M. Anders, C. D. Alton 1913
Lawrason Brown, Will Howard Swan 1914
Arthur K. Stone, James Alex: Miller 1915
Philip King Brown, Henry M. Bracken 1916
W. L. Dunn, Jabez H. Elliott 1917
W. G. Schauffler, H. M. Bracken 1918
Joseph H. Pratt, H. M. Kinghorn 1919
Charles W. Richardson, J. N. Hall 1920

Secretaries and Treasurers.

James B. Walker 1884–95
Guy Hinsdale 1895–1918
Arthur K. Stone 1918–

LIST OF MEMBERS.

Honorary Members.

Elected

1888. Abbot, Griffith E., 722, Main Street, Worcester, Mass.
1914. Blue, Surgeon-General Rupert, U. S. Public Health Service, Washington, D. C.
1914. Fox, R. Fortescue, 36, Devonshire Place, W., London.
1914. Garnett, A. S., Hot Springs, Arkansas.
1916. Gorgas, Major-General William C., U. S. A. War Department, Washington, D. C.
1914. Gros, Edmund L., 23, Ave. du Bois de Boulogne, Paris, France.
1917. Marvin, Prof. Charles F., Chief of the Weather Bureau, Washington, D. C.
1902. McBride, James H., Pasadena, Cal.
1914. Philip, Sir Robert W., Charlotte Square, Edinburgh, Scotland.
O.M.* Robinson, Beverley, 42, West 37th Street, New York.
1911. Stupart, Sir Robert F., K.B., F.R.S.C., Director, Dominion Meteorological Service, Toronto, Canada.
1898. Sunderland, Septimus, II, Cavendish Place, Cavendish Square, W., London.
O.M. Tyndale, J. Hilgard, 823, Terminal Bldg., Lincoln, Nebraska.
1917. Ward, Prof. R. De Courcy, Harvard University, Cambridge, Mass.
1907. Williams, Leonard L. B., 123, Harley Street, W., London.
1917. Wright, Sir Almroth, St. Mary's Hospital, London, England.

* O.M., Original Member.

Corresponding Members.

Elected

1912. Carpenter, Ford A., Central Building, 6th & Main Sts., Los Angeles, Cal.

1898. Eyre, G. G., Claremont, Cape Town, South Africa.

1911. Grenfell, Wilfred, C.M.G., St. Anthony, Newfoundland.

1912. Henderson, Professor Yandell, 440, Prospect Street, New Haven, Conn.

1908. Liston, Lieut. Col. W. Glen. C.I.E., Indian Medical Service, Director of the Bacteriological Laboratory, Bombay, India.

1910. Rogers Lieut.-Colonel Sir Leonard, C.I.E., F.R.S., F.R.C.S., Indian Medical Service, Professor of Pathology, Medical College, Calcutta, India.

1902. Weber, F. Parkes, 13, Harley Street, W., London.

1914. Wood, Neville, 42, Elvaston Place, Queen's Gate London.

Emeritus Members.

1897. Alton, Charles D., 1310, Asylum Avenue, Hartford, Conn.

1885. Ford, William E., Utica, New York.

1891. Quimby, Charles E., 278, West 86th Street, New York.

1890. Rogers, E. J. A., 222, Colfax Ave., Denver.

1887. Smith, Fremont, Bar Harbor, Maine.

Active Members.

1914. Alsever, Major William D., 727, East Willow Street, Syracuse, New York.

1899. Anders, James M., 1605, Walnut Street, Philadelphia.

1900. Arnold, Lieut. Col. Horace D., 520, Commonwealth Avenue, Boston.

1893. Babcock, R. H. 74, East Elm Street, Chicago.

1917. Baetjer, Major Walter A., 1400, Continental Bldg., Baltimore.

Elected

1915. Bailey, Walter C., 506, Beacon Street, Boston. (Lieut. Col. Amer. Red Cross.)
1898. Baldwin, Edward R., Saranac Lake, N. Y.
1901. Barlow, W. Jarvis, Security Building, Los Angeles, Cal.
1907. Barnes, Harry Lee, Wallum Lake, R. I.
1902. Bergtold, William H., 910, Metropolitan Building, Denver, Col.
1897. Blackader, Alexander D., 236, Mountain Street, Montreal, Canada.
1897. Bonney, S. G., Stedman Building, Denver, Col.
1895. Boardman, W. S., 63, Mt. Vernon Street, Boston.
1885. Bowditch, V. Y., 506, Beacon Street, Boston.
1901. Bracken, H. M., 4th St., S. E., Minneapolis.
1891. Brannan, John W., 48, West 51st Street, New York City.
1894. Bridge, Norman, Security Bldg., Los Angeles, Cal.
1903. Brown, Lawrason, 104, Main Street, Saranac Lake, N. Y.
1903. Brown, Philip King, Medical Bldg., San Francisco, Cal.
1897. Brown, Sanger, Kenilworth, Illinois.
1907. Browning, Major Charles C., Merritt Building, 8th and Broadway, Los Angeles, Cal.
1909. Bushnell, Col. George E., U. S. A., 10 Wood St., Concord, Mass.
1886. Butler, Major G. R., 226, Gates Avenue, Brooklyn.
1914. Byers, Capt. John Roddick, Ste. Agathe des Monts, P.Q., Canada.
1896. Campbell, W. A., 424, N. Nevada Ave., Colorado Springs, Col.
1918. Clark, Major Raymond, 310, Clinton Ave., Brooklyn, N. Y.
1906. Claytor, Thomas A., 1826, R. Street, N. W., Washington, D. C.
1901. Cobb, J. O., U. S. P.H. Service, Marine Hospital, 4141, Clarendon Ave., Chicago.
1894. Coleman, Major Thomas D., 986, Hickman Rd., Augusta, Ga.

Elected

1901. Collins, Charles Farnham, 830, Park Ave., New York City.

1889. Coolidge, A., 613, Beacon Street, Boston.

1917. Craig, Capt. Frank A., 244, South 21st Street, Philadelphia.

1910. Crane, Bayard T., Rutland, Mass.

1918. Crankshaw, Charles W., c/o Prudential Co., Newark, N. J.

1907. Da Costa, John C., jun., 1529, Pine Street, Philadelphia.

1892. Daland, Lieut. Commander Judson (U.S.N.R.F.), 317, South 18th Street, Philadelphia.

1890. Darlington, Major Thomas, 27, Washington Square North, New York City.

1907. Darnall, Wm. Edgar, 1704, Pacific Ave., Atlantic City.

1897. Davis, N. S., 7, West Madison Street, Chicago.

1905. Dunn, Major William LeRoy, Asheville, N. C.

1897. Edson, Carroll E., 517, Majestic Building, Denver, Col.

1915. Elliott, John Barnwell, jun., 608, Maison Blanche, New Orleans, La.

1903. Elliott, Lieut. Col. J. H., 11, Spadina Road, Toronto, Canada.

1912. Farrand, Livingston, Chairman Central Committee, Amer. Red Cross, Washington, D. C.

1910. Floyd, Cleveland, 246, Marlborough Street, Boston, Mass.

1917. Forster, Lieut. Col. Alexius M., Colorado Springs, Colo.

1911. Fulton, Frank Taylor, 373, Bowen Street, Providence, R. I.

1896. Gardiner, C. Fox, 1112, North Cascade Avenue, Colorado Springs, Col.

1892. Gibson, William M., 260, Genesee Street, Utica, N. Y.

1915. Goodman, Major Edward H., 248, South 21st Street, Philadelphia.

Elected

1909. Griffin, Walter Alden, Sharon, Mass.
1907. Hall, Major J. N., 452, Metropolitan Building, Denver, Col.
1912. Hamman, Louis V., 714, Park Avenue, Baltimore.
1893. Hance, I. H., Lakewood, N. J.
1891. Hart, James A., El Paso Club, Colorado Springs, Colo.
1912. Hatfield, Charles J., 381, Fourth Ave., New York.
1914. Hawes, John B., 2nd, 29, Gloucester Street, Boston, Mass.
1896. Heffron, John L., 608, East Genesee Street, Syracuse, N. Y.
1918. Heise, Fred H., Saranac Lake, New York.
1893. Hinsdale, Guy, Hot Springs, Virginia.
1902. Hoagland, Lieut. Col. Henry W., Colorado Springs, Col.
1914. Holden, G. Walter, Agnes Memorial Sanatorium, Denver, Colorado.
1888. Jayne, Lieut. Col. W. A., 408, Metropolitan Building, Denver, Col.
1901. Jennings, Charles Godwin, 457, Jefferson Street, Detroit, Michigan.
1915. Johnston, Collins H., Metz Bldg., Grand Rapids, Michigan.
1907. Kinghorn, Hugh M., 14, Church Street, Saranac Lake, N. Y.
1899. Klebs, Arnold C., 490, West End Ave., New York.
1917. Klotz, Walter C., 12, Rue Boissy-d'Anglas, Paris, France.
1910. Landis, H. R. M., 11, South 21st Street, Philadelphia.
1914. Lee, Lieut. Col. Roger I., Harvard University, Cambridge, Mass.
1914. Lichty, John A., 4634, Fifth Avenue, Pittsburgh, Pa.
1918. Litchfield, Major Lawrence, 5431, Fifth Ave., Pittsburgh, Pa.

Elected

1917. Lloyd, John, Iola Sanatorium, 151, Canterbury Rd., Rochester, N. Y.
1909. Locke, Edwin Allen, 311, Beacon Street, Boston, Mass.
1913. Lord, Frederick T., 305, Beacon Street, Boston.
1907. Lyman, David Russell, Wallingford, Conn.
1918. McLean, Lieut. Col. John D., Asst. Health Commissioner, Harrisburg, Pa.
1906. Manges, Morris, 72, East 79th Street, New York.
1902. Marvel, Philip, 1616, Pacific Avenue, Atlantic City, N. J.
1917. Matson, Major Ralph C., 1021, Corbett Building, Portland, Oregon.
1917. Matson, Ray W., Corbett Bldg., Portland, Oregon.
1917. Meader, Charles N., 518 Majestic Bldg., Denver.
1915. Mercur, Wm. H., 5244, Fifth Ave., Pittsburgh, Pa.
1905. Miller, James Alexander, 379, Park Ave., New York.
1909. Miner, Charles H., 115, South Franklin Street, Wilkes-Barre, Pa.
1899. Minor, Charles L., Asheville, N. C.
1917. Montgomery, Capt. Charles M., 2210, Locust Street, Philadelphia, Pa.
1907. Nichols, Lieut. Col. Estes, 199 Vaughn St., Portland, Maine.
1907. Nichols, John B., 1321, Rhode Island Ave., N.W., Washinton, D. C.
1917. Niles, Walter L., 893, Park Ave., New York.
1912. Norris, Col. George W., 1530, Locust Street, Philadelphia.
1888. Otis, E. O., Major M.R.C., 381, Beacon Street, Boston.
1913. Parfitt, C. D., Gravenhurst, Ontario, Canada.
1912. Paterson, Robert Childs, Saranac Lake, New York.
1906. Perkins, Jay, Lieut. M.R.C., 125, Waterman Street, Providence, R. I.
1895. Phillips, W. F. R., School of Medicine, Charleston, S. C.
1917. Piersol, Lieut. Col. George Morris, 1913, Spruce Street, Philadelphia.

Elected

1887. Platt, Walter B., 802, Cathedral Street, Baltimore.
1917. Porter, Capt. George D., C.A.M.C., 162, Crescent Road, Toronto, Canada.
1902. Pottenger, F. M., 1100, Title Insurance Building, Los Angeles, Cal.
1905. Pratt, Major Joseph H., 317, Marlborough Street, Boston.
1917. Price, Capt. J. Woods, Saranac Lake, N. Y.
1914. Probst, Charles O., 185, State Street, Columbus, Ohio.
1905. Pryor, John H., 26, Linwood Ave., Buffalo, N. Y.
1885. Rice, C. C., 123, East 19th Street, New York.
1901. Richardson, Lieut. Col. Charles W., 1317, Connecticut Avenue, Washington, D. C.
1904. Richer, A. J., Ste. Agathe des Monts, P.Q., Canada.
1917. Ringer, Paul H., Asheville, N. C.
1890. Robinson, W. D., 2012, Mt. Vernon St., Philadelphia.
1902. Rochester, Delancey, 469, Franklin Street, Buffalo.
1917. Russell, Nelson G., 469, Franklin Street, Buffalo, N. Y.
1918. Sawyer, John P., Rose Bldg., Cleveland, O.
1905. Schauffler, Col. William Gray, 400, Madison Ave., Lakewood, N. J.
1901. Sewall, Henry, 1360, Vine Street, Denver, Col.
1915. Shattuck, Major George Cheever, 205, Beacon Street, Boston.
1918. Shortle, A. G., Albuquerque, N. M.
1910. Shurly, Lieut. Col. B. R., 32, Adams Avenue W., Detroit, Mich.
1917. Smith, Wm. H., 10, Gloucester Street, Boston.
1911. Steiner, Walter R., 646, Asylum Ave., Hartford, Conn.
1909. Stevens, Martin L., Asheville, N. C.
1904. Stone, Arthur K., Lieut. M.R.C., Auburn St., Framingham Center, Mass.
1915. Stone, Major Willard J., Santa Barbara, Cal.
1910. Swan, Major John M., 475, Park Avenue, Rochester, N. Y.

Elected

1901. Swan, Major Will Howard, 20, East San Rafael Street, Colorado Springs, Col.

1892. Taylor, H. Longstreet, 810, Lowry Building, St. Paul, Minn.

1907. Taylor, Major J. Gurney, 330, Wells Building, Milwaukee, Wisconsin.

1896. Taylor, J. Madison, 1504, Pine Street, Philadelphia.

1910. Thomas, Capt. John D., The Farragut Apt. N.W., Washington, D. C.

1917. Waters, Bertram H., Loomis, Sullivan Co., New York.

1917. Webb, Lieut. Col. Gerald B., Colorado Springs, Col.

1911. White, William Charles, Major, Amer. Red Cross, Bedford Ave. and Wandless St., Pittsburgh, Pa.

1898. Whitney, H. B., 320, Temple Court, Denver, Col.

1898. Williams, Harold, 528, Beacon Street, Boston.

1885. Williams, H. F., 416, Grand Avenue, Brooklyn.

1911. Williams, Lieut. Col. Linsly R., 884, Park Ave., New York.

1910. Wilson, Gordon, 4, East Preston St., Baltimore.

o.m. Wilson, James C., 1509, Walnut Street, Philadelphia.

1917. Wilson, Robert, jun., 165, Rutledge Ave., Charleston, S. C.

1913. Wood, Nathaniel K., 520, Beacon Street, Boston.

THIRTY-SIXTH ANNUAL MEETING OF THE AMERICAN CLIMATOLOGICAL AND CLINICAL ASSOCIATION HELD AT ATLANTIC CITY, N. J., JUNE 14, 16 and 17, 1919.

DR. GUY HINSDALE PRESIDING.

Secretary's Report.—Read. Moved and seconded that it be accepted and put on file.

Treasurer's Report.—Read. Moved and seconded that it be received and sent to the Auditing Committee.

The resignation of a certain member was referred to Council for discussion. No objections.

Report of Council on Recommendation of Membership.

Report of Auditing Committee.—The books were examined and found to be correct. Moved and seconded that report be accepted and filed.

Nominating Committee.—Begs to report the following:

For President—Dr. Lawrason Brown.
For 1st Vice-President—Charles W. Richardson.
For 2d Vice-President—J. N. Hall.
For Secretary and Treasurer—Arthur K. Stone.
For Recorder—Wm. Duffield Robinson.
Delegates to Executive
Committee—Thomas Darlington, James M. Anders.
Member of Council—Guy Hinsdale.

Casting of Votes for Membership.

Report from Tellers.—Twenty-four votes unanimously for the candidates.

Motion made that $150 be appropriated to the Secretary and Treasurer for typewriting for the fiscal year. Carried.

Motion made that $50 be appropriated for expenses of the Recorder. Carried.

Motion made that vote of thanks be given to the Local Committee, Dr. Philip Marvel, chairman, for the happiness of the Association. Carried.

Motion made to adjourn. Carried.

After calling the meeting to order the president said: In opening the 36th annual session of this Association we find ourselves once more together renewing, I am sure, our devotion to the fraternal spirit that has bound us together for all these years. There are now only three living members of the group that founded the society. Dr. Tyndale, who took the most active part in its inception, is living but at such a distance we never see him. Our other original members, Dr. Beverley Robinson and Dr. James C. Wilson, still honor us at times with their presence and active interest.

I, myself, can count twenty-five years of active membership. With you I look back on such delightful companions as dear old Dr. Curtin, Dr. Walker, Dr. Knight and Dr. Solly, not to mention those who have gathered round the Council board in recent years.

Some of us are now back from camp and the army hospitals and we are proud of the fine record each has made. We shall hear later something about the work they have done and the lessons they have learned in the military and naval service of the United States and their allies. Some have won distinction in the service of the Red Cross and in the Rockefeller Commission for the Study and Prevention of Tuberculosis and are even now detained by duties of the most important character.

AN APPRECIATION OF SIR HERMANN WEBER.

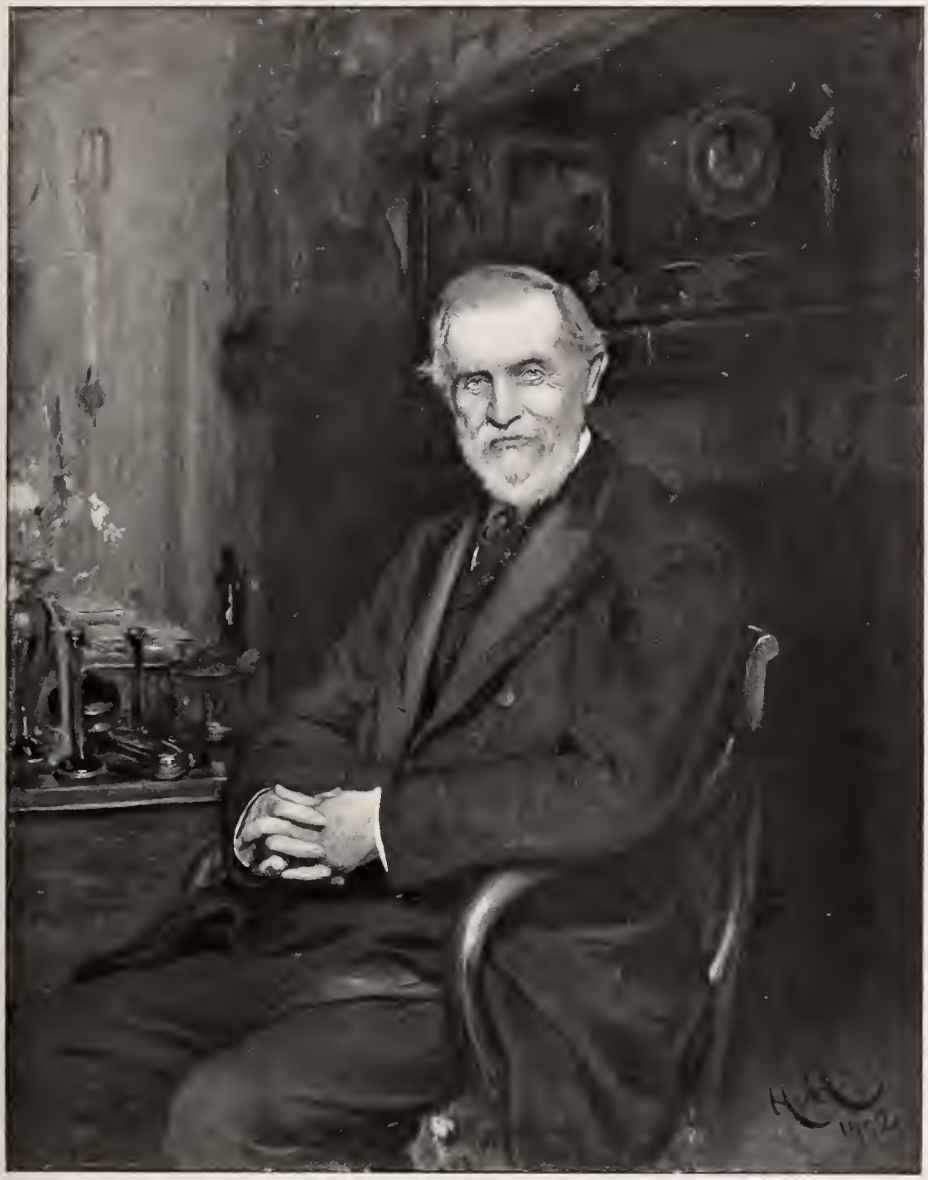
By A. JACOBI, M.D.,

NEW YORK.

Hermann Weber was a lifelong friend of mine. I knew him first at Bonn in 1849, after having left the University of Goettingen in 1849. My sojourn at Bonn lasted from my sixth semester, 1849 to 1851, where after my eighth semester I was graduated in medicine in April, 1851.

Hermann Weber was born December 30, 1823, of a German father and an Italian mother. His early years were spent in country life in Bavaria and Hesse-Cassel, and he studied in Fulda until he left for the University of Marburg. Here he met Carlyle during his medical studies. From Marburg he changed to Bonn, where his relations with Englishmen were still more frequent. It was here that Sir Perigrine Maitland, Sir Henry Havelock, and Sir James Simpson gained an influence on the active young man. It was through them that his studies of Shakespeare, and of English in general, became more matured and his English future more established.

It was in Bonn that he graduated in medicine, 1848, and built the foundation for his future greatness, his position there being that of first assistant of the medical clinic of the university. As such, he prepared the lectures of the professor, Friedrich Nasse, for whom he was the superintendent of the medical clinic. In that capacity he controlled the clinic-dispensary work, which, under Nasse, was quite extensive, the number of patients from the poorer classes treated at the clinic being very large, consisting of adults and children, both surgical and medical cases. All the advanced students were in charge of patients, in great part responsible work. The professor himself participated in the active work, which was guided by the actual assistants, whose



PORTRAIT OF SIR HERMANN WEBER, FROM THE OIL-PAINTING OF 1902, BY SIR HUBERT HERKOMER, R.A.

activities were many. The students were occupied many hours every day, and their labors did not end with the death of the patients, as our school work was not closed until the post-mortem and epicrises were finished.

The most important factor in my labors in Bonn was the methodical teaching at the university. There was but one instructor in Germany comparable with Nasse, namely, Krukenberg of Halle. Indeed these two clinics were the only thorough ones in German universities. These two professors were actually in contact with French teaching. We students were fully aware of what was going on in France under Laënnec and Piorry, and were quite superior in attainments to the students in Vienna, where Skoda taught and Rokitansky demonstrated.

It is characteristic in the life of Hermann Weber that while he continually studied and learned, he never ceased to teach. I early adopted his methods, and never forgot them. I learned from him to combine the study of the case and the obligation to the human creature when treating a patient, and I applied his theories in later life when teaching. My connection with American teaching institutions were of the same nature, both scientifically and humanistically. I have been assured that my influence as a general teacher has been the result of what was inculcated by my lifelong friend and teacher, Hermann Weber. There should be more such friends and more such teachers.

His first public position in England was that of house physician in the German Hospital of Dalton, in the General Hospital of London, where I met him a few times after I landed in England as a refugee. Meanwhile I felt that our paths had diverged considerably. He had applied for membership in the Royal College of Physicians, to which, after studying in Guy's Hospital, he was elected a fellow at the same time as Dr. William Odley, in 1855. About that time he joined the "Society for Clinical Observation," which attracted all the younger men—his co-workers—of the London profession; and from that time dates his friendship with Addison, Edmund Parkes, Wilson Fox,

Hilton Fagge. It was then that he established the "Weber Parkes Prize" of £3000 for a triennial prize on the study of tuberculosis, which was finally awarded five times altogether.

"Tuberculosis," "phthisis," "consumption" were his lifelong topics of study and close exertion. The British profession has not failed to recognize them. On the Council of the Royal College of Physicians he served as a censor in 1879 and 1880. The honor of knighthood came to him in 1899. He became a consultant physician to the Royal National Hospital for Consumptives at Ventnor; to the North London Consumption Hospital; to the Committee of King Edward VII Sanitarium, and of a great many British and foreign learned societies. All must have been sources of intense satisfaction to him, but the keenest interests of the warm-hearted man were his lifelong sympathies with poverty, sickness, and humanity.

A great many of Weber's publications may be found mentioned in the two series of the Index Catalogue of the Surgeon General's Office, Vols. XVI of the 2st, and XXI of the 2d series. Extensive treatises of his form several editions of Ziemssen's Cyclopædia of 1880, of Quain's Dictionary, and of Allbutt and Rotherton's "System of Medicine." His Croonian lectures before the Royal College of Physicians in 1885 treated extensively of phthisis, like others of his special studies. His "Notes on the Climate of the Swiss Alps" (1864), his "Treatment of Phthisis by Residence in Elevated Regions," belong to this class.

Many results of his studies were embodied in an extensive book published with his son, Dr. F. Parkes Weber, the last edition of which, "Climato-therapy and Balneo-therapy," appeared in 1907.

An obituary published in the *Lancet*, of December 7, 1918, speaks of him in warm words. "The claims of climatology were publicly recognized by his knowledge of the subject, Hermann Weber being an ardent mountain climber all over the Alps and Apennines." His winter tours and his recommendations of

Switzerland, Tyrol, and Italy were generally well known. His adventures in the Alpine Club were matters of extensive knowledge. In his sixty-eighth year he climbed the Wetterhorn and the Jungfrau; in his seventy-third year he became known for extensive Alpine trips. He did not give them up until he reached his eightieth year. They made him the great judge "amongst half a dozen of British prime ministers and a number of members of the royal English family." One of my personal letters from him, which was burned in a fire September 20, 1918, speaks enthusiastically of his climbing the Mount Sinai mountain in Arabia "a few years previously."

He was medical officer to the Central office of the North British and Mercantile Insurance Company for many years; was president of the Life Assurance Medical Officers from 1897 to 1899; and his presidential address on heredity in relation to life assurance showed considerable prevision in respect to matters that have since become subjects of more elaborate discussion and arrangement.

In connection with his extensive active and scientific studies on tuberculosis, those on the muscular tissue are easily appreciated.

His main care was the treatment of the muscular tissue. In his last posthumous paper* he referred to much of what he had taught for decades: "According to the directions given by Hippocrates, the principal movements ought to be those of walking, but arms and other limbs should be exercised similarly, not only of the young, but of the old, always in relation to the different ages and conditions of physical heat. Friar Roger Bacon knew that the body heat decreased after the age of forty" (1683).

The effects of the muscular actions on different parts of the body are pointed out, as follows:

1. Increased afflux of blood to the muscles with each contraction.

* "De Prolongatione Vitæ," *Brit. M. J.*, February 23, 1918.

2. Increased nutrition of the muscle combined with improved metabolism and production of body heat.

3. Increase of exchange of fluid between blood and tissues.

4. Facilitation of the removal of waste products.

5. Preservation of the elasticity of the thorax and lungs.

6. Abundant supply of oxygen for the blood and the metabolism.

7. Maintenance of the healthy condition of the organs of circulation, from the heart to the smallest arteries, capillaries, and lymphatics.

8. Massage of the bones, keeping up the healthy condition of the bone substance and the bone marrow, and through this the formation of a sufficiency of blood efficient for the fight with hostile bacteria entering the blood.

9. Increase of the resisting power of the body against disease.

10. Persistence of the working capacity of the brain centers, which initiate the action of the different sets of muscles.

This last paper of his is characterized by assiduity, like every one of his endeavors. Even when he participated in the "Festschrift in honor of A. Jacobi, M.D., LL.D.," 1900, p. 14, in his "A Contagious Form of Pneumonic Fever in Children," he displayed the same exactitude. Even in this special article he extended his general knowledge upon the patients of advanced years.

Hermann Weber died November 11, 1918.†

JOHN H. LOWMAN, 1849–1919.

By E. R. BALDWIN,

Presented by Dr. Paterson.

The death of our fellow and colleague occurred in New York City about thirty-six hours after his arrival from Italy. He had been acting as director of the American Red Cross Tuber-

† This memoir is also contributed to the Osler Anniversary Volume.

culosis Unit in that country since October, 1918, but had sufferred an attack of influenza, from which he did not recover. He died suddenly and unexpectedly, undoubtedly from the exhaustion due to his efforts in Italy combined with the epidemic disease. He died in active life and was keenly anxious to serve to the limit of his strength.

Dr. Lowman was widely known and foremost as a medical man and citizen in his home city, Cleveland. Where human welfare was concerned, he was pretty sure to lead in an effort to promote it. One who knew him as intimately as anyone writes: "In spite of his busy practice and his teaching connection with the Western Reserve Medical School (as professor of clinical medicine) he found time for important and lasting service to his community. Our entire system of social-medical dispensaries and the coöperative plan upon which our medical charities are based originated with him and had in him a constant inspiration and support. Lowman possessed a very rare gift for combining and mobilizing human effort for definite ends. He proved to the satisfaction of a large group of people representing about twenty organizations that they were already doing work which if concentrated and placed under strong scientific direction would immensely increase their efficacy."

As a result the Western Reserve Anti-tuberculosis Dispensary was opened in 1906 and supported by the above-mentioned societies. "The Babies Dispensary and Hospital of Cleveland owed its origin to a similar analysis of the local situation which he made and to his skill and wisdom in bringing together several unrelated efforts in the interest of babies. He had a very analytical mind and a kind of wisdom that made him conscious of the immense usefulness latent in individuals whom one meets every day without discovering and who often fail of the best that is in them because they are without suggestion, direction and encouragement. He always read a great deal—philosophy and poetry enchanted him. He was extraordinarily faithful in all his obligations, both public and private, so that his family, his friends, his community feel and share a common sorrow."

Truly these are expressive tributes to a physician, a teacher of varied interests and a man of culture.

Dr. Lowman was well informed, had travelled considerably and seriously studied subjects such as tuberculosis, in which he did effective medical and social work for his home city.

As a companion he was far from commonplace in conversation, always ready with some facts of unusual moment and ready to learn from the humblest source. Dr. Lowman will be missed among us for his charm and qualities of heart as well as his devotion to the best in medical ideals.

He leaves a wife, Isabel Wetmore Lowman, and three sons, John Wetmore, Henry Mather and Shepard Wetmore Lowman. Two sons served as pilots in the air service in the Great War.

Lowman, John H., of Cleveland, Ohio, was born in that city in 1849.

He graduated from the Wesleyan University, Middletown, Conn., in 1871, receiving from the same institution the degree of A.M. in 1874; and the degree of M.D. from the Medical Department of Wooster University, Cleveland, in 1873. From 1872–1874 he was House Surgeon in Charity Hospital, Cleveland, and 1874–1875 House Surgeon at the New York City Hospital, Blackwell's Island; while there he organized the throat clinic, which developed the next year into a regular service with three visiting surgeons. He was also the first student in the Metropolitan Throat Hospital. At that time it was his purpose to specialize in laryngology. In 1877 he received the *ad eundem* degree from the College of Physicians and Surgeons of Columbia University, New York City. Returning to Cleveland, he began the general practice of medicine and surgery in that city, where he continued in active general practice up to the time of his death.

In 1875 he was appointed Lecturer on Materia Medica in the Medical Department, Wooster University in Cleveland, and in 1876 chosen Professor of Materia Medica and Therapeutics in the same University, which position he held until 1881, when the consolidation with Western Reserve University took place and he began his long and continuous connection with the faculty of that institution, holding during the 38 years of service the following professorships in the Medical Department:

1881–1889, Professor of Materia Medica.
1889–1893, " " Medicine.
1893–1909, " " Medicine and Clinical Medicine.
1909–1912, " " Clinical Medicine.
1912– " " Clinical Medicine and Ethics.

In 1877 he was appointed one of the Visiting Physicians to Charity Hospital and of Lakeside Hospital, Cleveland, continuing to hold the latter to the time of his death.

In the earlier part of his medical career he made a specialty of diseases of the throat and air passages, and later on was recognized as one of the leading authorities on tuberculosis. He was one of the vice-presidents of the International Medical Congress at Rome in 1893; was a member of the Cuyahoga County Medical Society, of the Ohio State Medical Society, the American Medical Association, the American Climatological and Clinical Association, the American Laryngological Association, and the National Tuberculosis Association, of which he was president, 1913–1914. He was the founder and president of the Anti-Tuberculosis League of Cleveland, and one of the founders and a leading spirit of the Ohio State Tuberculosis Society, and president of the same, 1909 to 1912. His socio-medical interests were not confined to tuberculosis work, as was shown by the important part that he played in the development of infant welfare work in Cleveland and the interest that he gave to it until his death.

In September, 1918, Dr. Lowman left with the Italian Tuberculosis Commission of the American Red Cross, as its medical director. In Italy he contracted the so-called influenza, which so undermined his health that he sailed for home early in January, but died on January 23, 1919, on the second day after his arrival in New York. In Dr. Lowman's death Cleveland loses one of its eminent physicians.

1849. Born, Cleveland.
1871. Graduated A.B. at Wesleyan University, Middletown, Conn.
1873. Graduated M.D. at Wooster Medical College, Cleveland, Ohio.
1872–1874. House Surgeon at Charity Hospital, Cleveland.
1874. Degree A.M. Wesleyan University, Middletown, Conn.
1874–1875. House Surgeon of Charity Hospital, Blackwell's Island, New York City.
1875. Began practice of medicine and surgery in Cleveland.
1875. Lecturer on Materia Medica in Medical Department of Wooster University.
1876. Chosen Professor of Materia Medica and Therapeutics in Wooster University.
1877. Visiting Physician Charity Hospital, Cleveland.
1877. Degree ad eundem from College of Physicians and Surgeons, Columbia University, New York City.
1877. Visiting Physician to Lakeside and Charity Hospitals, Cleveland, and consulting physician to various other hospitals.
1881–1889. Professor of Materia Medica and Therapeutics in Western Reserve University.
1889–1893. Professor of Medicine, Western Reserve University.
1893–1909. Professor of Medicine and Clinical Medicine, Western Reserve University.

1909–1912. Professor of Clinical Medicine, Western Reserve University.
1912–. Professor of Clinical Medicine and Ethics, Reserve University.
1913–1914. President, National Association for the Study and Prevention of Tuberculosis.
1909–1912. President Ohio State Tuberculosis Society.
1905.– President Cleveland Anti-Tuberculosis League.

ABRAHAM JACOBI.

Dr. Jacobi was born at Hartum, Westphalia, Germany, May 6, 1830. He studied at the universities of Greifswald and Göttingen, graduating from the University of Bonn in 1851. He was intimately identified with the German revolutionary movement in 1848 for which he was imprisoned for two years under a charge of high treason. In 1853, while under sentence, he escaped to England and attempted medical practice unsuccessfully at Manchester, and then migrated to America, settling first in Boston and later moving to New York City. In 1860 the New York Medical College established the first professorship of diseases of children and invited Dr. Jacobi to accept this chair. This position he held until 1864, when he accepted a similar position in the University of New York. In 1870 he became professor of pediatrics in the College of Physicians and Surgeons, holding this position for twelve years and retiring as emeritus professor.

During a long career Dr. Jacobi held practically every honor which the medical profession can give.

In 1889 he joined our Association and in 1900 was elected president. He was twice president of the American Pediatric Society; was president of the Association of American Physicians in 1896; of the New York Academy of Medicine from 1885 to 1889; and of the American Medical Association, 1912–'13. He made a point of attending the meetings of societies to which he belonged, read valuable papers and was a leader in discussion.

Born May 6, 1830. Died at Lake George, New York, July 10, 1919.
President, 1900.

As a contributor to medical literature he is perhaps best known for his work on the intestinal disturbances and the therapeutics of infancy and childhood. His most important papers, monographs and addresses were assembled some years ago in eight volumes in the Collectanea Jacobi.

As one of his lifelong friends, Dr. Reginald H. Sayre said at the funeral services in the New York Academy of Medicine, it was to children chiefly that Dr. Jacobi had devoted his great skill and lifelong adherence to the duties of his calling:

"A great light in the medical profession has gone out, Abraham Jacobi is dead, but his influence still lives and it will be felt as long as children are born and require medical care.

"Cast off by the country of his birth, which failed to recognize in his striving for improved conditions among its people the prophetic vision of the future, and saw in it only the destruction of the present. Dr. Jacobi came to the United States. He had nothing then but his inherent ability to aid him, yet, starting at the very bottom of the ladder, he received every honor which lay within the power of the medical profession of the world to bestow.

"He reached a place of such eminence that the very country that cast him in prison for his revolutionary ideas as a young man, turned to him in his maturer years and besought him to return and accept a professorship in Berlin. But, faithful to the land that had welcomed him when he was thrust out of his native country, the doctor declined the glittering offer.

"This position he refused with the historic words 'I was, I am, rooted to the American profession that I have observed to evolve without governmental aid out of its own might to become equal to any on the globe.'

"It is most fitting and proper that these funeral services should be held in the Academy of Medicine, as this building itself constitutes a monument to his wisdom, foresight, and sagacity. The academy was very dear to Dr. Jacobi's heart, and to it he devoted an extraordinary amount of his time and attention.

"It was through Dr. Jacobi and Dr. Loomis* that the site on which this academy stands was purchased, and it was largely through his efforts that the money to erect the building was secured. Its interests were always foremost in his thoughts, and when, after serving two terms as president and twenty-three years as president of the board of trustees, he resigned from the active management of its affairs, he continued to be a constant attendant at any meeting of public importance. His advice was always sought on matters of business by those in direct control of this institution.

"As an officer of this association for twenty years, I was brought into very intimate contact with Dr. Jacobi, and I realize more fully, perhaps, than any one else how deeply his heart was wrapped up in the institution and how zealously he guarded against any step which he thought might tend to its injury.

"For many years Dr. Jacobi attended all the meetings of all the various sections of the academy, taking a part in their different discussions. What he had to say was always to the point and always worth listening to. It was marvelous that one mind could be broad enough and one man have time enough to keep in touch with such a vast range of different topics and be intelligently informed on all.

"Dr. Jacobi's learning was founded on a solid substratum of common sense, and he never allowed his judgment to be led astray by the fashionable medical novelty of the hour, which is taken up for a time and lauded by the ignorant, only to be discarded after experience has failed to demonstrate the truth of the claims made for it.

"He felt that the physician should do more than heal the sick. It was his ideal to prevent sickness, pointing out by timely advice in regard to modes of life how many of the preventable diseases might be avoided.

"He had a large share in establishing the cooperation between the profession of medicine at large and the local Board

* The first president of the American Climatological Association.

of Health, which became really effective for the first time during the threatened cholera epidemic in 1892.

"His voice was heard whenever he felt the city or country was menaced by any danger. Wherever he decided he owed a duty to the people of this nation, either as a man or physician, to raise a voice of protest against evils whether they had to do with the realm of medicine or not, he never hesitated to speak. He never talked at random and so his words were ever listened to with respect, and his suggestions had a weight of authority seldom accorded to any one.

"Few doctors since the time of Benjamin Rush have had the influence in directing the thought of this country that was exercised by Dr. Jacobi. His style was epigrammatic, and his nice distinction in the use of English terms was peculiar. Few people could say as much in a few words, or say it to so good effect.

"To the young men who showed promise of ability he was always most kind and generous, and many a prominent man in this city can trace his rise in life to the helpful advice of Dr. Jacobi. The poor, as well as the rich, were welcome at all times to his aid. And any litle child that was suffering called forth all the great depth of sympathy that was his.

"We shall miss his wise advice, his kindly face, and pleasant smile, but we may all rejoice that he was taken in full mental vigor, and that, as it were, he fell asleep among friends."

There was scarce a sound in the hall as Dr. Sayre finished speaking and remained awhile with bowed head before the casket. Then he took his seat, and the quartette sang "Lead Kindly Light."

The interment followed late in the afternoon at Greenwood Cemetery.

This volume contains what he had expected to read at our meeting, his last contribution to the Society of which he was so fond and of which every member holds him in affectionate remembrance. It is the appreciation of his lifelong friend, Sir Hermann Weber, of London. G. H.

Dr. Jacobi married Dr. Mary Putnam in 1873, the first woman to graduate from the Medical Department of the University of Paris, and one of the first to practise in the United States.

Dr. Jacobi had the honorary of LL.D. conferred on him by the universities of Michigan, Columbia, Yale and Harvard and the Jefferson Medical College.

At the dinner given to Dr. Jacobi on his seventieth birthday anniversary Dr. S. Weir Mitchell read the following beautiful tribute:

ABRAHAM JACOBI.

MEDICUS, MAGISTER, AMICUS.

No honors hath the State for you whose life
From youth to age has known one single end.
Take from our lips two well-won titles now,
"Magister et Amicus"—Master, Friend.

From the gray summit of attainment you
Look on the rugged path you knew to climb.
Take, with our thanks, for high example set
The palm of honor in this festal time.

Constant and brave, in no ignoble cause,
The hopes of freedom armed thy sturdy youth;
As true and brave in the maturer years
Thy ardent struggle in the cause of truth.

Nor prison bars, nor yet the lonely cell,
Could break thy vigor of unconquered will;
And the gray years which build as cruel walls
Have found and left thee ever victor still.

Ave Magister! take from us tonight
The well-earned praise of all who love our art
For this long lesson of unending work,
For strength of brain and precious wealth of heart.

Your busy hand gives much; but, oh, far more,
The gallant soul that teaches how to meet
Unfriended exile, sorrow, want, and all
That crush the weak with failure and defeat.

We gave you here a home; you well have paid
With many gifts proud freedom's generous hand,
That bade you largely breathe a freer air
And made you welcome to a freer land.

Ave Amice! If around this board
Are they who watched you through laborious years,
Beyond these walls, in many a grateful home,
Your step dismissed a thousand pallid fears.

That kindly face, that gravely tender look,
Through darkened hours how many a mother knew!
And in that look won sweet reprieve of hope,
Sure that all earth could give was there with you.

Ave Magister! Many be the years
That lie before thee, thronged with busy hours!
Ave Amice! take our earnest prayer
That all their ways fair Fortune strew with flowers.

BOSWELL P. ANDERSON.

Colorado Springs, Colo.; University of Virginia, Charlottesville, 1868; Washington University Medical School, Baltimore, 1869; aged 72; a Confederate veteran; at one time president of the Colorado State Medical Society; for more than forty-five years physician and surgeon to the Colorado State Blind and Deaf Institute; president of the staff of St. Francis' Hospital, Colorado Springs; for ten years chief surgeon and thereafter consulting surgeon to the Colorado Midland Railroad; died at his home, August 25, from angina pectoris.

CONSTITUTION AND BYE-LAWS.*

CONSTITUTION.

Article I.—Name.

This Society shall be known as the American Climatological and Clinical Association.

Article II.—Object.

The object of this Association shall be the Clinical Study of *Disease, especially of the Respiratory and Circulatory Organs, and of Climatology and Hydrology.*

Article III.—Membership.

Section 1.—This Association shall consist of *active, corresponding, Emeritus,* and *honorary* members, the former not to exceed 150 and the latter not to exceed twenty (20).

Section 2.—Names of candidates for active membership, whose applications shall have been endorsed by *three* (3) active members, shall be sent to the Secretary at or before the annual meeting at the second business session of which they shall be read and then lie over until the next annual meeting, when such as are approved by the Council shall be balloted on. Three (3) black balls shall be sufficient to reject a candidate. The Council shall have power to nominate active members.

Candidates for membership shall, at the discretion of the Council, present a paper to the Association showing clinical study of merit.

Section 3.—The power of nominating honorary and corresponding members shall be vested in the Council. The election shall be conducted in the same manner as that for active mem-

* As amended May 10, 1916.

bers. Honorary members shall enjoy all the privileges, but shall not be allowed to hold any office or cast any vote.

Section 4.—Anyone who has been an active member of this Association for twenty (20) years in good standing, and has attained the age of sixty (60) years, may become an Emeritus member by expressing his desire to do so, in writing to the Council, and he shall thereafter be exempt from all dues and duties of the Association.

Section 5.—Any member of the Association absent from the meetings, in person or by contributed paper, for three (3) consecutive years, without sufficient cause, shall be dropped from the list of members by vote of the Council.

Article IV.—Officers.

Section 1.—The officers of this Association shall consist of a *President*, two *Vice-Presidents*, a *Secretary and Treasurer*, and a *Recorder*, who, with the Delegate to the Executive Committee of the Congress of American Physicians and Surgeons or his alternate and five other members, shall constitute the *Council* of the Association.

Section 2.—*Nominations.* The officers, including the Council, shall be nominated by a committee of five (5) members, which committee shall be nominated by the President at the first session of each annual meeting and shall report at the business meeting.

Section 3.—*Elections.* The election of officers shall take place at the business meeting. A majority of votes cast shall constitute an election.

Section 4.—The President, Vice-Presidents, Secretary and Treasurer, and Recorder shall enter upon their duties at the close of the annual meeting at which they are elected, and shall hold office until the close of the next annual meeting, or until their successors are elected.

Section 5.—Members of the Council, other than the President, Vice-Presidents, Secretary and Treasurer, shall hold office for five (5) years.

Section 6.—*Vacancies.* Any vacancy occurring among the officers of the Association during the year may be filled by the Council.

Article V.—Duties of Officers.

President and Vice-Presidents.

Section 1.—The President and Vice-Presidents shall discharge the duties usually devolving upon such officers. The President shall be *ex-officio* Chairman of the Council.

Secretary and Treasurer.

Section 2.—As Secretary, he shall attend and keep a record of all the meetings of the Association and of the Council, of which latter he shall be *ex-officio* Clerk. At each annual meeting he shall announce the names of all who have ceased to be members since the last report. He shall notify candidates of their election to membership. He shall send a preliminary notification of the annual meeting two (2) months previous thereto, and the programme for the annual meeting at least two (2) weeks previous to its assembly, to all the members of the Association. He shall also send notification of the meetings of the Council to the members thereof. At each annual meeting of the Association he shall read the minutes of the previous meeting and of all the meetings of the Council that have been held during the current year.

Section 3.—As Treasurer, he shall receive all moneys due, and pay all debts therewith. He shall render an account thereof at the annual meeting, at which time an auditing committee shall be appointed to report.

Recorder.

Section 4.—The Recorder shall secure the papers read and also proper notes of the discussions thereon and shall superintend, under the direction of the Council, the publication of the Transactions.

Article VI.—Council.

The Council shall meet as often as the interests of the Association may require.

Four (4) members shall constitute a quorum.

It shall have the management of the affairs of the Association, subject to the action of the Association at its annual meetings.

It shall consider the claims of candidates recommended to it for admission to membership.

It shall not have the power to make the Association liable for any debts exceeding in total one hundred dollars ($100), in the course of any one year, unless specially authorized by a vote of the Association.

It shall have the entire control of the publications of the Association, with the power to reject such papers or discussions as it may deem best.

It shall have power to nominate active members at the annual meeting.

The Council shall have power to invite any gentleman, not a member, to read a paper at the annual meeting, on any subject within the scope of the objects of this Association.

The Council shall determine questions by vote, or—if demanded—by ballot, the President having a casting vote.

The Council shall constitute a Board of Trial for all offences against the Constitution and Bye-laws, or for unbecoming conduct, and shall have the sole power of moving the expulsion of any member.

The President, or any two members, may call a meeting, notice of which will be transmitted to every member two (2) weeks previous to the meeting.

Article VII.—Papers.

Section 1.—The titles of all papers to be read at any annual meeting shall be forwarded to the Secretary not later than one (1) month before the first day of the meeting, in order to appear on the printed programme.

Section 2.—No paper shall be read before the Association which has already been printed or been read before another body.

Article VIII.—Quorum.

A quorum for business purposes shall be ten (10) members.

Article IX.—Amendments.

This Constitution may be amended by a four-fifths (4/5) vote of all the members present at an annual meeting, provided that notice of the proposed amendment has been printed in the notification of the meeting at which the vote is to be taken.

BYE-LAWS.

(1) Meetings of the Association shall be held annually.

(2) The time and place of the meetings shall be determined by the Council.

(3) The dues of active members shall consist of an annual assessment not to exceed seven and a half ($7.50) dollars. Members in arrears shall not be entitled to vote. Those in arrears for two (2) years may be dropped from membership by recommendation of the Council.

(4) Order of business meeting.

First day:—

Calling the roll of members.
Minutes of previous meeting.
Secretary's and Treasurer's reports.
Recorder's report.
Report of Committee of Arrangements.
Appointment of auditing committee.
Appointment of nominating committee.
Report of Council on recommendations for membership.

Second day, Morning session:—

Reports of nominating committee and auditing committee.
Election of officers.
Election of members.
Nomination of candidates for membership.
Report of committee on health resorts.
Unfinished business.
Miscellaneous business.
Adjournment of business meeting.

AMERICAN CLIMATOLOGICAL AND CLINICAL ASSOCIATION
FIAT LUX
FOUNDED 1884.

PRESIDENT'S ADDRESS.

THE SUN, HEALTH AND HELIOTHERAPY.*

By GUY HINSDALE, A.M., M.D.,

HOT SPRINGS, VIRGINIA.

THE relation of the sun to human health and the vital functions is of such great importance that any phase of this subject is deserving of serious consideration. We are accustomed to accept without question the beneficent influence of solar light and heat, knowing as we do that the actinic and chemical solar rays are necessary for the maintenance of animal and vegetable life upon our globe. These influences reveal themselves in greater or less degree according to the seasons and in the various zones into which we divide time and place in our planetary existence.

But meteorologists and astronomers and students of geophysics are constantly dealing with problems of more subtle type and have devised instruments, the very names of which are scarcely known beyond the physical laboratories and observatories now maintained for research in these hidden realms of the solar and terrestrial forces. Among them we may mention as preeminent in this field the Carnegie Institution of Washington, with its department of research in terrestrial magnetism; the geophysical and physico-chemical laboratories and the solar observatory on Mount Wilson, in California, belong to the Smithsonian Institution.

Besides the astrophysical laboratory at Washington the Smithsonian Institution maintains an observatory at Calama,

* The president called attention to the fact that the seal of the Association represents the sun with rays in all directions. Motto, "Fiat Lux."

Chile, one of the most arid regions on the globe, where there is perennial sunshine and rainfall is almost unknown. During the past year two Smithsonian observers have been recording daily by means of delicate instruments known as vacuum bolometers the amount of radiation from the sun. The results are telegraphed daily to the Argentine Government, where they are made the basis for temperature forecasts; the results are said to be very promising. From the observatory records in Chile and those at Mount Wilson in California, taken during the last fourteen years at an elevation of 5,700 feet, it appears that the amount of radiation from the sun varies from day to day as well as from year to year, showing that the sun itself is a variable star, due in part to the remarkable periodicity of sunspots and similar phenomena; the shorter perodicity is probably to be explained in changes in the transparency of the outer solar envelope.

We are familiar with the work of our United States Weather Bureau with its trained experts and well-equipped research laboratories; so also with the excellent weather service of the Dominion of Canada; and it is fitting to add that we count the chiefs of both these bureaus among our honorary members.

The British Empire has its Meteorological Society with observatories at Kew, Greenwich and Stonyhurst; France, its Société Astronomique under the direction of the distinguished M. Flammarion and, in addition, the Bureau Central Météorologique.

The sun is an immense source of energy; but the gravitational or potential, thermal, optical, actinic and magnetic effects are the only ones that have as yet been measured. There is no doubt but that the magnetic field of the earth's surface is affected by disturbances upon the sun; the electrical field in the earth's atmosphere is also affected, at least indirectly, by the radiation from the sun. The electromagnetic influences of the sun and moon on the magnetic needle at the earth's surface have been observed for many years and a magnetic influence may be attributed to the same forces that produce sunspots. This is a form of electrical energy transformed into magnetism.

Whenever so-called magnetic storms are manifested by the auroral light or by disturbance on our telegraph wires or ocean cables these are explicable in general as the transformation of waves of electric influence or energy, analogous to those in our aerial or wireless telegraphy.

Sunlight has the power of ionizing the air but there is a marked difference in the degree of ionization between that of the air at sea-level and at higher stations. Even in strong sunshine the surface air is only slightly ionized but at the height of a few miles, as in balloon ascensions, the ionization may be twenty times as great as at the surface. Sunlight has also been found to have the power of discharging the antennæ of wireless stations. It has also been found that rays received vertically have far more ionizing power than those received tangentially. Electric rays travel best by day in the narrow shell of dialectric between some stratum in the middle atmosphere and the surface of the earth.

It is admitted that the earth is negatively electrified and the atmosphere positively. This negative electrification of the earth is probably not uniform and we know that currents of greater or less intensity exist. The states of atmosphere vary considerably in the amounts of positive electricity they hold; but owing to the proximity of these differently electrified bodies there is a strain between them to establish an equipoise or, in other words, the tension may at times be broken by the earth giving up negative electricity and the atmosphere giving up positive electricity in order to form an equilibrium. The intensity with which this seeks to be established is called potential. The electroscope shows this by the behavior,—the divergence, of the gold leaf. George Mahomed,* of Bournemouth, illustrates very well this matter of potential by depicting a pointed, towering rock that tends to get rid of negative and attract thereby positive electricity, when the potential in the neighborhood will

* A. G. S. Mahomed, *Proceedings Royal Society of Medicine*, December 8, 1909, Vol. III, and 1913, Vol. VI, p. 157–164.

be relatively high. Air currents condensed into a cloud in the higher strata would carry a positive charge; while those formed on the ground or the side of a mountain would probably carry a negative charge. If clouds of these two types should meet a sudden alteration of potential would result. The author has frequently witnessed such an interchange in the mountains of Virginia. In the western portion of the State there are numerous parallel ridges with deep and narrow intervening valleys. It occasionally happens that an electric discharge takes place from the summits of these ridges into the atmosphere. There is nothing audible but merely a sudden glow of the higher clouds in the dark night and it is possible that the presence of iron-bearing strata in the mountain ridges may have something to do with determining the electric tension thus manifested. "Andes lightning" is the name given to a similar luminous discharge seen over the crest of the Andes, in Chile, in a region where ordinary thunderstorms are almost unknown. The mountains appear to act as gigantic lightning rods, between which and the clouds silent discharges take place on a vast scale. Whether these phenomena have any solar connection, that is, whether they are induced by previous exposure to solar radiation, we do not know. Such phenomena are observed elsewhere.

We know that the sun is positively electrified and the earth negatively and we would expect the potential to be highest near the surface of the latter. Mohamed and Dr. Chree have studied the diurnal variation in terrestrial magnetism and they find that the winter maximum is about 10 A.M. and in the evening about 6 to 8 P.M. In summer it is about 8 A.M. and 8 to 10 P.M. The morning minimum is about 4 A.M. throughout the year. In winter the weather conditions which accompany a high barometer favor the existence of high values and big diurnal changes in the potential; but in summer the barometric readings and the mean, the range, of daily variations of potential seem to have no relation.

Mohamed suggests that the heating of the earth's surface

gives rise to a better ionization of adjacent portions of the earth's atmosphere; it is a fact, probably, that no discharge of electricity takes place in the absence of electrons. These minutest particles of negative electricity have a velocity comparable to that of light. It is further known that the magnetic currents have a daily motion from west to east, that this motion is most marked in the tropics, while other currents go from the tropics to the poles; these latter through their property of deflecting the electrons into their course give rise to the *aurora borealis*.*

Periodicity of Sun Spots. The mean is 11.13 years. From data furnished by courtesy of Smithsonian Institution, Washington. (See also *Monthly Weather Review*, 30, p. 171, 1902.)

Sun spots, which are probably due to the irruption of masses of hydrogen, calcium, etc., are probably attended with high ionization and hence give rise to the disturbances of the magnetic fields on the earth's surface. It is probable that in these magnetic disturbances at the earth, very indirectly of solar origin, there may be some subtile influence on the human nervous system.

It was shown by Hale that there are magnetic fields in sun spots. He was aided by the work of Zeeman, who discovered that powerful magnetic fields may split an ordinary single spectrum into several components.†

* The fact that terrestrial auroras, northern lights and southern lights follow the sunspot periodicity and with this periodicity there is also a noteworthy change in the earth's magnetic field is clearly shown by Dr. C. G. Abbot in his work on "The Sun," Appleton and Co., New York.

† "All solar rays, whether visible or photographically active or not,

But are the sun spots after all potent for good or ill as far as we are concerned? Very few aside from professional astronomers have ever seen them, but nevertheless they appeal strongly to the popular imagination. There is, undeniably, much mystery about them. These fascinating phenomena are huge uplifts of metallic vapors in which vanadium, titanium and iron are evident; while at the top of these immense vortices there is an inflow of hydrogen and vapor of calcium. As they expand, lose heat and absorb solar light they appear dark by contrast; so that instead of 6000 C. which is the estimated temperature of the sun's surface their temperature drops to approximately 3500° C. The magnetic field which has been detected in sun spots is believed to be due to the friction of the various vapors and gases and chemical compounds in the stupendous whirling motion which characterizes them.

All this has a very important commercial and military bearing when we consider that the sun itself can take a hand in the conduct of the great war; not that the sun should stand stil' as in the days of Joshua in the battle of Ajalon, but that it should tie up the great wireless plants on which modern warfare relies for aid.

With the cutting of the German-owned Atlantic cable at the beginning of the war Germany had to fall back upon her wireless plants in order to transmit news and official or diplomatic messages through a channel not controlled by her enemies. For this the Sayville station on Long Island, New York, for a time became the distributing center, the wireless messages being thence transmitted by neutral cable or telegraph to all

produce heat when absorbed upon a blackened surface. Sometimes the infra-red rays are called heat rays, the light rays, visible rays and the blue, violet and ultra-violet 'active' or 'photographic rays'; but there is no distinction of kind between these things." "All are regarded as transverse vibrations of the luminiferous ether, differing only in wave-length."

"Waves of all wave-lengths produce their just effects when transformed into heat. Though both are forms of energy, radiation is not heat but may be transformed completely into heat. We regard radiation as wave motion in the ether, heat as irregular motion of the molecules of material substances."

parts of the world. But when the aurora borealis appeared in May, 1915, the service was suddenly severely handicapped and for several weeks the messages received were for the most part fragmentary or impossible to decipher. The same situation existed at Tuckerton, near Atlantic City, New Jersey, much to the dismay of the German owners.

We think it a very significant fact that electric waves, as, for example, those used in wireless telegraphy, travel with the velocity of light, or at the rate of 186,330 miles per second and it suggests a very close relationship, more than a mere analogy, between light and what we designate as electricity.

Radiant energy, proceeding from the sun, may be held to include light, heat and electricity and it might be unjustifiable to differentiate too closely between them as we have been wont to do in the past. As we have intimated, our knowledge of some of these attributes of the sun is of very recent date. As Dr. Abbot the director of the astrophysical observatory of the Smithsonian Institution, says in his work: "That which the sun sends to the earth in such abundance used to be considered as three distinct things namely,—actinic, or chemical, rays; light, or visible, rays; heat, or invisible, rays. These distinctions are known to be misleading. * * * All rays may be totally transformed to produce heat, however they may differ in their effect upon the eye, or on different chemical substances. All these rays travel with equal velocity in free space."

We are thus compelled to take a very broad view of solar radiation and to give to the electric energy of the sun a wider scope than at first thought would seem appropriate. Thus it is that heliotherapy may owe some measure of its efficiency to the electric energy of the sun.

We all know that disturbances of the nervous and mental equipoise are often traceable not only to social environment but to climatic conditions and, in the belief of the ancients, and even of some of the present day, to lunar influences. That solar irradiation has a considerable influence is undoubtedly

true. It is constant; clouds may intervene but cannot wholly check its power.

There is at the present time a remarkable and growing interest in heliotherapy and it has won an established place in the treatment of tuberculosis of the bones and joints and of the lungs. There is a notable tendency to extend the use of this method to a large variety of surgical affections in the military hospitals. It is systematically applied in these affections at suitable stations in the Alps and on the French coast, both on the Mediterranean and Atlantic shores. It has been carried out with marked success at Alton in Hampshire, England. In America some systematic experiments have been made, but it is in Switzerland and France that the most thorough and painstaking methods have been adopted. One of the most ardent exponents of heliotherapy is Dr. A. Rollier who during the last sixteen years has treated about two thousand patients, both children and adults, by graduated exposure to solar irradiation at his institution in Leysin, near St. Moritz, Switzerland.

At the French marine stations, notably Berck-Plage and Cannes, the same method of treatment is adopted and the same good results obtained. The proportion of cures in very advanced and apparently hopeless cases of "surgical" tuberculosis seems incredible. Rollier has claimed about 75 per cent. of cures and his clinical reports fortified with photographs taken on admission and discharge dispel what might be pardonable incredulity. Rollier trains his patients, both children and adults, by systematic and strict methods always adapted to the individual case, so that they live in the free air of the Alps almost wholly naked but, apparently, in perfect comfort. The training begins with exposure to the air and, afterwards, exposure to the sunlight. Under no circumstances does Rollier allow the patient to be exposed to the sun on the same day or on the day following his arrival in the mountains. According to the gravity of the case or the general resistance of the patient, from three to ten days are allowed for acclimatization to the altitude and training for

the air cure. Children seem to display a remarkable tolerance for exposure to sunshine.

Sunlight has considerably more actinic force at these mountain stations than the at seashore and hence the time required for the Alpine stations is probably less than elsewhere. But Rollier and his Swiss colleagues have strongly urged the adoption of heliotherapy at the seashore sanatoria and this is now quite as successfully accomplished.

Dr. Albert Robin, in his work on tuberculosis cites the well-known facts that the luminosity of the sea air and the power of the solar radiation at the seaside are very intense. The refraction of light by the sea water gives special properties with luminosity. The sea water absorbs the ultra red rays that are calorific; it reflects the yellows (luminous) and the blue and violet rays that are chemical rays, the bactericidal action of which is recognized. Light is one of the best health giving agents; stimulates all the acts of animal life, particularly oxidation. The luminosity of the sea air helps, then, to give it a more stimulating action than does the air of inland regions.*

Dr. Robin believes that the sodium chloride, iodine and silica (which he showed to be present at Berck-Plage) must exist in sea air in a state of ionization, or perhaps in a physical form which develops their radioactive properties. They increase the phenomena of oxide reducing hydrolysis which occupy the first rank in acts of disassimilation in organic life. This makes us suspect, if not state precisely, the important part that must be taken by the chemical elements contained in sea air. All of them stimulate the exchanges, this in itself being one of the conditions of remineralization.

In America there is every opportunity for practicing heliotherapy for tuberuclosis and in the wider field which included many chronic medical and surgical conditions not necessarily tubercular. There are now in military hospitals many cases of

* Albert Robin, "Treatment of Tuberculosis" (English translation), J. and A. Churchill, London, 1913, p. 380.

tuberculous disease of the bones and joints; and, in addition, there are the inevitable torpid wounds, fistulas, frost bite, "trench foot" and the effects of caustic gases lately a part of military practise. Many of these sufferers are sent to Vichy, Aix-les-Bains, Bagneres-de-Luchon, Cauterets and Lamalou-les-Bains for the baths; others are sent to Berck-Plage and to Cannes and other marine stations for the additional help of heliotherapy.

Again we strongly urge the establishment of a true sun cure in the Rocky Mountain region, preferably Colorado, New Mexico, Arizona and California. Among the places where heliotherapy has been attempted on this side of the Atlantic there is a wide difference in the amount and quality of sunshine, the *sine qua non* of successful treatment; nevertheless it has been carried out in such diverse climates as those found at Sea Breeze Hospital Long Island, Narragansett Bay, Rhode Island, at Perrysburg, forty miles from Buffalo, and Toronto, Canada. Success has attended the efforts of members of this association stationed in Colorado, and southern California where the hours of sunshine are most uniform and least liable to interrupt the cure.

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A TUBERCULOSIS SCHOOL FOR PATIENTS AND OBSERVATION HOSPITAL

By JOSEPH H. PRATT, M.D.

BOSTON.

In the tuberculosis crusade so vigorously conducted throughout this country during the past ten years one feature absolutely essential to the success of the campaign was neglected and that was the practical instruction of physicians and nurses in the proper treatment of tuberculosis.

In this war against tuberculosis we are fighting the foe of all humanity, a foe so strong that it has won easy victories over mankind from the earliest times recorded in medical history until the present day. The officers of our new and great American Army had a thorough practical training before they entered the firing line against the enemy. What a contrast our army fighting tuberculosis presents! Volunteers in large number sprang to arms at the call of the leaders who formed the National Association, and at once took up the fight. There was great enthusiasm in those days, and the hope of speedy success in curing the disease and preventing its spread. The general practitioner was spoken of as "the man behind the gun" and it was assumed that without special training he could beat the enemy. The favorite rallying cry was "Tuberculosis is a curable disease," with no thought of Brehmer's wise observation expressed in the qualifying phrase "but a difficult disease to cure." Another slogan indicative of the spirit of that time was "No tuberculosis in 1915."

There was general agreement that the patients should work and live in the fresh air, and have an abundance of nourishing food. The treatment advocated was simply an out-of-door life. Patients in the early stages of the disease who lived in the city

were often advised to move to the country if they could afford to do so and to spend as much time as possible in the open air. No emphasis was placed on rest. In the circular of instructions regarding treatment issued as late as 1908 by the board of health of a state that has taken a prominent part in anti-tuberculosis work, the word rest was not even mentioned. As the treatment to be followed was nothing more or less than an out-of-door life, the need of special training for physicians in the treatment of tuberculosis was not apparent.

The tubercle bacillus kept grimly at work and continued to slay his thousands upon thousands every year and in every part of the country. In spite of the fact that real progress was being made against the foe, the fond hopes of recovery that were awakened in the hearts of most of the tuberculous patients were not realized. Much is said, and with reason, about the need of educating the patient, but it is obvious that until the physicians learn the right way of treating cases of tuberculosis it will be another case of the "blind leading the blind."

The establishment of the Trudeau School of Tuberculosis is an event of great importance and significance in the anti-tuberculosis campaign. Now for the first time the opportunity is presented to any physician who is dealing with tuberculosis to receive a short but systematic course of instruction in the diagnosis, pathology and treatment of the disease from teachers of distinction.

After years of uncertainty regarding the right method of treatment the evidence that has been accumulated clearly shows that the rigid rest treatment during the active stage of the disease is the proper one and that it yields brilliant results in curable cases when properly carried out. How firmly this fact is now realized was well brought out at the meetings of the Climatological Association and the National Tuberculosis Association at Boston in June of last year. To the convincing statements of Kinghorn, Brown and Dunn at those meetings in favor of rest, should be added those recently published by Colonel

Bushnell. The agreement of these men not only in the general principle but in the details of treatment, reached independently as a result of long experience, will render the instruction of the rank and file of tuberculosis workers an easier task.

There is no doubt that failure to employ the rest treatment explains the lack of success in the treatment at many public sanatoriums and nearly all dispensaries and in private practice. As I have pointed out elsewhere, even the amount of modified rest which Brehmer and Dettweiler, the pioneers of modern treatment, used in their sanatoria is not given patients in many of our public sanatoria today. Patients are still given leaflets of instruction at dispensaries in which they are advised to rest for half an hour or if possible "a little more, before and after each meal."

Now that the claims of the advocates of graduated labor have been disproved, there is reason to hope that within a year or two the bed-rest treatment will be much more used. Its adoption has doubtless been hastened by Dr. Lawrason Brown's excellent book on "Rules for Recovery from Pulmonary Tuberculosis."

The records of the Emmanuel Church Tuberculosis Class, covering now a period of thirteen years, prove that tuberculosis can be cured at home in a large percentage of cases if the patients follow the strict rest treatment. Seventy-six of the first and second stage cases were well one to ten years after their discharge. The patients followed the bed rest treatment without strict supervision because they believed it offered them the best chance of recovery. Out of 220 patients brought to a class meeting, 217 agreed to follow the rest treatment and of these only 11 gave it up after one to two weeks' trial. All the remainder, 206 in number, became regular members. In view of the experience of many physicians that their patients, especially of the laboring class, refuse to take the rest treatment, it is remarkable that 206 out of 220 candidates for admission to the tuberculosis class were willing to give up all exercise and to spend

their days and nights out of doors in bed. A single meeting of the class usually furnished a sufficiently convincing demonstration to the new comers to make them willing, if not eager, to begin the rest treatment at once. They saw patients who looked strong and well who a few months before had been sick like themselves. They heard these members say that their steady and rapid gain was a result of prolonged rest. The stories told of the rapid disappearance of symptoms and the gain in strength and well being as a result of bed rest in the open air, aroused the hopes of the visitors and usually made them resolve within themselves to follow the treatment faithfully. The new-found faith in the treatment was strengthened by the physicians in charge of the class whose experience had convinced them of the remarkable results the rest treatment yielded, and in whose minds there was no shadow of doubt in recommending it to the new patients. Furthermore, the nurse who visited the patients' homes was equally strong in her belief and could explain in detail to the patient and to the family the benefits to be derived from the treatment. During the past six years the nurse in charge has been a living witness of its value and could give her personal testimony, as she owed her own recovery from tuberculosis to the bed-rest treatment, carried out at home when she was a member of the class.

Admitting this to be true, how can the lessons learned by this experiment in home treatment be applied to the treatment of large numbers of consumptives, for example those in the cities and towns of Massachusetts? Critics, with justice, say that we have treated only a small number of cases, and what are they "among so many"? It takes some knowledge and experience to run a tubërculosis class successfully, and a method that requires an expert to care for twenty-five or even fifty consumptives a year certainly offers no solution to the problem of combating tuberculosis as a disease of the masses.

The plan I propose for utilizing the knowledge gained by our experience, and which would enable us to use the same successful

methods in modified form, is the teaching and observation hospital. It might be called a tuberculosis school for patients, physicians and nurses in the same sense as our form of tuberculosis clinic has been called a class.

I have worked out this plan in some detail for the State of Massachusetts, but it could be applied to any other state, or county, for as one will see it is capable of application anywhere, if money is available, because it can cooperate with existing sanatoria or tuberculosis hospitals, or be used independently of these in countries where they do not exist at present. Essentially, as I will explain later, it is a school for home treatment. As the majority of all cases of tuberculosis must be treated at home, and as sanatorium treatment must be followed by home treatment in the form of after-care, any plan for treatment that is to merit serious consideration must give promise of solving the difficult question of adequate home treatment.

The tuberculosis work in Massachusetts is better organized and better equipped than in most states. There are four state sanatoriums for cases in a curable stage under a special board of trustees; county hospitals for advanced cases under the supervision of the Department of Health; some municipal tuberculosis hospitals, tuberculosis dispensaries in the larger cities and towns; a board of nurses connected with the State Department of Health under the direction of a single head. These nurses help and oversee the work of the visiting tuberculosis nurses connected with the many tuberculosis dispensaries, who in turn visit and instruct the patients in their homes.

The ideal observation hospital, as I have conceived it, would be an institution for twenty cases with single rooms for the patients. There would be long covered porches where the beds could be placed both day and night. There would be a well equipped x-ray department under the direction of an expert and a laboratory where research work could be done as well as routine examinations made. The institution would be under the direction of the Commissioner of Health of the State. For the chief

physician would be selected a man experienced in both the diagnosis and treatment of tuberculosis. He should devote at least half of his time to the work and the pay should be sufficient to secure the services of the right man.

The resident physician should be well trained in physical diagnosis, and with a good general knowledge of internal medicine. Much of the routine clinical work could be done by internes and voluntary assistants.

The nursing and social service work should be under the supervision of the chief nurse in the Department of Health, who now directs the work of the tuberculosis nurses in the different health districts into which the state is divided. Tuberculosis nursing and home visiting requires special training and the hospital would serve as a training school for tuberculosis nurses.

Physicians and nurses engaged in the various forms of tuberculosis work in the state could come to the hospital for short periods of intensive training.

Patients would be admitted for observation and instruction in treatment. They would come for a week or two only. This would be sufficiently long to teach them thoroughly the importance of rest, the details of the bed-rest treatment, and to give the necessary instruction in the use of the thermometer and in pulse taking and in the keeping of record books. They would be requested to read carefully selected articles and certain chapters of books that have been helpful to other patients. In a part of the building a small tuberculosis exhibit would be arranged, to instruct and encourage the patients. Simple talks on treatment and allied subjects would be given several times during the week, illustrated with lantern slides. This instruction would be given by physicians, nurses and social workers of sufficient experience to inspire the patients with confidence.

Once a week a tuberculosis class could meet at this tuberculosis center, and the patients would have this opportunity to learn from patients wholly or partly restored to health, what the rest treatment has done for them. Experience has taught

that the testimony of a patient who has recovered himself, especially if he looks well and strong, carries conviction when the statements of doctors and nurses fail to do so.

A careful medical record of the case would be made with detailed notes on the history and physical examination, and supplemented by x-ray and laboratory tests. A carbon copy of the record with the opinion of the medical staff regarding diagnosis and treatment would be sent to the patients' private physician when the patient left the hospital. A social record would be made by a social worker, which would cover all the non-medical aspects of the case. A carbon copy of this would go to the visiting tuberculosis nurse of the town from which the patient came. During the week an appointment would be made by the social worker with members of the patient's family when they visited the hospital, for the purpose of explaining to them the importance of rest treatment and of inspiring them with confidence in the methods to be used.

The medical staff would decide whether the patient had clinical tuberculosis and advise regarding the place of treatment, whether in sanatorium, county hospital or at home. Sanatorium would doubtless be recommended for most of the favorable cases, but as there is an interval of time of from four to eight weeks frequently after application is made before admission is secured, the patient would be instructed to spend this time taking the bed-rest treatment at home.

After leaving the observation hospital, supervision at home would be maintained if the private physician approved, by means of (1) the use of the daily record book, (2) visits and reports from the district or town nurse, (3) reports from the private physician; (4) the patients would be instructed to write a weekly or semi-monthly letter to be sent with the daily reports detached from the record book. To this a prompt reply would be sent, either a personal note or a carefully prepared circular letter, giving encouragement and additional instructions or emphasizing certain points such as the need of learning the art of physical and mental relaxation.

This correspondence method of directing treatment has been tried with success in a number of cases. One patient, with long-existing chronic pulmonary tuberculosis with slight fever and positive sputum, has followed the rest treatment under my direction by the correspondence method for the past eight months, with such success that his sputum is now negative, his temperature normal, cough and sputum have almost disappeared and his weight has increased ten pounds.

When the patient leaves his home for sanatorium or county hospital he could take with him, with the consent of his physician, a complete record of his history, examinations and a statement of the progress he has made. He would enter the institution benefited in health, with greater self control than before his illness, and with a knowledge of the proper method treatment as well as a knowledge of the dangers of over exertion.

The educational influence of such a tuberculosis school or hospital, if properly conducted, would soon extend throughout the whole state. It could give the necessary instruction and training to from 500 to 1,000 patients a year. The patients, so instructed, would help the other patients with whom they were later associated, many of whom now enter hospitals and sanatoriums ignorant of the essential features in the treatment of the disease. Patients started in the right way at the observation school would help the institutions which they entered by improving the morale of the other patients. The careful clinical and the x ray and laboratory findings that they brought with them would assist the physicians and enable them to check off their observations with those of others.

The district nurses would be assisted and aided in their work by the support given them, as well as by the opportunities the school would offer for additional training. Such an institution would also provide facilities, by means of demonstrations, case studies, conferences and special clinics, to the medical men of the state sanatoriums and hospitals for increasing their diagnostic skill, for developing their knowledge of treatment and for

kindling anew their enthusiasm in the scientific and practical aspects of the tuberculosis problem.

DISCUSSION.

Dr. F. M. Pottenger: Dr. Pratt has discussed one of the most important questions in the treatment of tuberculosis. Rest seems to be so simple that few know anything about it. When rest is applied to greatest advantage it must be applied with the same degree of care as any other remedy. I feel that the application of rest during the active stage of tuberculosis is the most important therapeutic measure that we have at our disposal.

The psychology of the tuberculous patient is a very important thing. In considering the treatment of soldiers it must be borne in mind that many of these men are in the sanatorium against their will, they want to go home, they have not come of their own choice, and consequently they are not apt to coöperate as fully as patients in private practice. Unless the coöperation of these patients can be gained through close and sympathetic attention, in other words unless they can be converted to an optimistic coöperation the treatment will fail. The treatment of tuberculosis consists in reëducation of the tuberculous patient and a reconstruction of his life. If the patient at the end of his treatment continues to do as he pleases, instead of having had impressed upon him the consciencious adherence to a carefully planned program, the result of treatment will most likely fail. Before a patient is discharged from treatment he should not only have secured the best result that can be obtained, but he should also have been helped to overcome other deficiencies that he may have. He should not give up treatment until a high degree of physical strength has been obtained; and he should also be taught how to live most efficiently without expenditure of a large amount of energy.

THE TREATMENT OF TUBERCULOSIS IN THE ARMY HOSPITALS.

By HENRY W. HOAGLAND, M.D.

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My subject, "The Treatment of Tuberculosis in the Army Hospitals," covers a much larger field than can be treated in one paper, and I shall therefore deal with the subject only in a general way; particularly as the work of the various departments of Oteen is being presented at this congress by different members of my staff. Also my personal experience only covers two of these institutions which I organized and served as commanding officer for the period from February, 1918, to March, 1919, and hence am only competent to speak in regard to these two institutions.

The Surgeon General's Office established six new institutions and greatly enlarged Ft. Bayard and Whipple Barracks, the two army hospitals which had been previously used for the treatment of tuberculosis prior to the war. In addition to these two just mentioned, hospitals were established at New Haven, Conn., Otisville, N. Y., Markleton, Pa., Waynesville and Oteen, N. C., and Denver, Col.

In the fall and winter of 1917 the rapid increase in the army necessitated the establishment of these hospitals as soon as possible, and time being an important factor, it became necessary to take over such hotels, hospitals, or sanatoria which were already built, and to use these pending the erection of modern plants. Hence the bane of the Canadian Medical Department became at once the bane of our own Surgeon General's office—the hotel hospital.

The first institution I organized was U.S.G.H. No. 17, at Markleton, Pa. This consisted of one large building which had

been used as a sanatorium for nervous diseases. It was three stories in height and had an elaborate hydrotherapy department. Fortunately the building had one large porch which extended on three sides of it, and accommodation was found on this for ninety patients. Several of the large assembly rooms were made into wards and as soon as possible, six tubercular shacks, type K-14, which is a modification of the King Shack, were erected. So that when I was relieved from that station we had accommodation for about three hundred patients.

Those of you who have served in these hotel hospitals know the grief with which we had to contend. Poor plumbing, bad electric light wiring, inadequate heating system, falling plaster, absolutely unsanitary and inadequate kitchen facilities, which in a plant run to capacity or over capacity, means an added strain on the equipment; but I desire to state that with all we had to contend, while it made the work much harder for every one in the command, from the C. O. to the rookie kitchen police, I do not know of a single instance where a patient suffered, or did not receive the proper care and attention needed—in any of these hotel hospitals.

But if these institutions were not all that could be desired, the hospitals built for permanent institutions are the most modern of their kind and are of great credit to the Surgeon General's Office.

I want to briefly describe U.S.G.H. No. 19 at Oteen, N. C., and will then take up the treatment of the soldier, as it was identical in each institution. Oteen is six miles from Asheville at an altitude of about 2,300 feet. It is a city in itself, and was built from the ground up. One year ago it was part corn field and part primeval forest. Today it has miles of cement roads, spacious lawns, flower gardens, has a total of 97 buildings, its own power plant, laundry, garage, barber shop. post exchange, and houses 2,600 men. It might properly be roughly divided into a lower reservation more or less level as to topography, and and upper or hill reservation situated three quarters of a mile from the former.

My experience of four months at Markleton, Pa., was of great help in establishing the hospital at Oteen. The hardest problem to overcome was the morale of the soldiers. It must be remembered that these boys were discouraged and homesick and many felt that they were dumped into a hospital for consumption where it was only a question of months until they died. To aid in the treatment of this mental condition one of the first things I did at Oteen was to find a suitable name for the institution. "Oteen" was chosen as it is the Indian name for "Chief Aim"; and around this I built the spirit of the institution. The officers, nurses and enlisted men of the medical detachment were repeatedly instructed that their "chief aim" while at Oteen was to do absolutely all in their power for the care and treatment of these soldiers. The patient was told that his "chief aim" was to cooperate in every way with the Command in order to make every day count in becoming a cure or an arrested case. And it seems to the writer that no single agency accomplished *more* for the success of Oteen, and has proven that after all there is something in a name.

In the organization and administration of an army hospital many points had to be kept in mind, several of which I desire to mention. For instance, a system had to be found to insure that among fifteen hundred patients not a single soldier should fail to receive the daily personal care of a medical officer; for it was realized that the constant daily care of the patient was more important in tuberculosis than in almost any other disease. To this end the hospital was divided into six separate units,—the receiving wards, the infirmary wards, and four groups of ambulatory wards. Over each of these groups was placed an officer, with a rank of major or captain, and under him was an officer for each individual ward. The officer in charge of individual groups was held responsible for the care of the wards under him, and to the Chief of the Medical Service.

Also as a further safeguard and as a means to identify a patient, or rather a type of patient, all cases were classified

as to the extent of their lesion. They were classified as an A, B, C or D case. Naturally the individual classification varied with the progress of the case.

A method was also used not only to enable greater efficiency in the organization, but to give to each man a concrete example of his improvement a system of rotation was followed. Patients were admitted to the receiving wards: the history, clinical findings, x-ray, sputum and urine examination made; the men were given short talks on what tuberculosis is, its treatment and cure, and the case classified as to A, B, C and D. Apart from the x-ray the receiving wards had their own laboratory to expedite removal of the patient as soon as possible to the institution proper. Naturally, if an active on arrival, the soldier was sent to the infirmary wards; if inactive or if an infirmary case had passed from a D to a C class in the infirmary wards, he was sent to one of the groups of ambulatory wards corresponding as far as possible to his class; the C cases going to the group nearest the mess in order to limit the length of walk necessary going to and from meals; until finally the patient progressed to class A, or the arrested case, when he was sent to the hill wards where he was fitted to be returned to active duty,—or after the amistice was signed, to civil life. These A cases were made to wear brassards, were given certain prescribed privileges and liberties, and were considered the graduating class. In other words, the men were examined, diagnosed, educated as to tuberculosis, classified, and started on a regular course of progression.

The Reconstruction Department.—To reiterate, it must be remembered these men came to us discouraged and depressed. They had entered the service imbued with patriotism, and had caught some of the glamor of army life; in course of time had gone before the examing board, told they had tuberculosis and sent to us. At Markleton I was at my wits' ends to know what to do to help them. Then at last Colonel Billings came to the rescue, and at my request a reconstruction department was established. No single agency ever changed the morale of an

institution as did the establishment of this department. There was almost an immediate improvement in the mental attitude of the patient. He was told he not only could regain his health, but at the same time could educate himself to be more useful not only to his country but in after life to himself. An illiterate could learn to read and write. A bookkeeper could become a stenographer. A farmer could learn something of the science of farming. And, gentlemen, how they jumped at the opportunity. At Oteen courses were established in knitting, basketry, bead work, drawing, writing, stenography, bookkeeping, wireless telegraphy, shoemaking, tailoring, light carpentering, automobile mechanics, landscape gardening, farming and the three R's. In the silent ward for laryngeal cases, telegraph instruments were provided and these men taught to converse with each other by the Morse Code.

But many of these occupations meant exercise, and we were dealing with tuberculosis. So that in order to safeguard the patient the following system was established: First, it must be remembered that not all medical men are tuberculosis specialists. Hence the entire medical staff were instructed and informed that while exercise was one of the most dangerous remedies, it was also one of the best aids in the treatment of tuberculosis, but that it had to be prescribed as one would prescribe morphine, cocaine or strychnia; that it was desired that as soon as possible these men should be hardened as well as cured. The system carried out was first to tie to the ward surgeon—the man who came in daily contact with his patient—the responsibility for the prescribing of work or exercise. Blanks were regularly filled out and signed by the ward surgeon. The man was sent to the reconstruction department with a prescription that he could do fifteen minutes, a half hour, one hour's work, or whatever time in the judgment of the ward surgeon he considered safe; and that the work should be light, medium or heavy. On presentation of this prescription a conference was held with a member of the reconstruction

department and the man's preference for the type of work he desired was decided upon. A general order was issued that a half hour after returning to the ward from active exercise, the patient's pulse, temperature and respiration were taken, and upon this daily record depended the increase or decrease of his exercise. As a further safeguard, a competent physician was detailed to this department to supervise from a medical standpoint. If, for instance, a man was noticed doing work too heavy for him, or dyspnœic or excessive coughing followed, he was immediately returned to his ward; or if he failed to report for work, a personal visit was made by this officer not only to the ward surgeon but to the patient himself to ascertain the cause. If due to increased temperature or pulse, consultation was held as to that particular case. Hence, you can readily see that every safe-guard was placed around the patient.

The subject of the entertainment of the men was given considerable thought. It was believed that while soldiers, these patients were yet young men—one might say overgrown boys—and preferred to entertain themselves rather than to be entertained. Several field days were held when light games were indulged in and a spirit of rivalry between the various wards was deliberately encouraged. Among fifteen hundred men taken from all parts of the United States and all walks of life, considerable talent was found. Among the ambulatory patients a complete orchestra was organized and regular concerts were given. Also once a month a full vaudeville show was pulled off. Small groups of three to six men were organized who regularly visited all of the infirmary wards, giving a short concert after supper. These concerts were immensely enjoyed by the bed patients. It was found that the entertainment of these men by one of their own number was of greater interest than where outside talent was brought in.

You will notice that I have placed the entertainment feature in with the reconstruction.

I have gone into this subject in more or less detail, for I

consider that the reconstruction or educational department conceived as an aid to the man who has lost an eye or a hand or both feet, has become by its establishment in the tuberculosis hospitals of the Army, one of the greatest advances in the treatment of tuberculosis. In regard to the criticism of its being exercise, I know full well that you are all not in accord with my views; but, gentlemen, I feel very strongly that we have cured or arrested tuberculosis and have given our patients a fat, flabby body with slight resistance to anything but tuberculosis; and that by careful attention we can undoubtedly arrest them quicker by the judicious use of graduated exercise; and also that a fair part of the cure is psychological, and that if you can keep a man's hands and mind busy you will the sooner cure him. And I feel strongly that this side of the treatment has been overlooked by many of the sanatoria, and that it should be a part of the treatment, and an important part in every institution.

I have not gone into detail in regard to such things as fresh air, rest, or a balanced ration, as that is a foregone conclusion. There were one or two minor questions which had to be carefully handled; one of which may be of interest was smoking. Much can be said on either side in regard to the use of tobacco but to limit it I issued an order "smoking would only be allowed one hour after each meal," thinking this would not restrict their individual liberty too much and yet would limit the excessive use of tobacco.

A fairly strict military discipline was carried out. These men though incapacitated, were soldiers of the United States Army, and all A and B cases were made to stand retreat with the enlisted men of the medical department. There were many other interesting features in regard to the treatment of these men which I have not the time in this paper to mention; but my one thought was to so regulate their day that every hour was accounted for; that while they slept or ate or worked, or had their exercise or amusement, they were living a life enabling them to get well; and that time should pass quickly for them.

It seems to me that after twenty years spent in the treatment of tuberculosis, that the year spent as commanding officer at two of the army hospitals brought out several points that could or should be of great value. First: that large bodies of men suffering from tuberculosis can be treated in one institution if a proper system is established. Second: that it has been proven that exercise properly prescribed is a more valuable remedy than we imagined. And third: that in every institution for the treatment of tuberculosis a reconstruction or educational department should be established.

DISCUSSION.

Dr. C. L. Minor: It has seemed to me that the greatest difficulty that is met with in army tuberculosis hospitals is the creation of a proper atmosphere among the patients. To do this with a thousand to fifteen hundred men seems impossible and the constant change of medical officers in charge of the wards, which seems to be unavoidable in the Army, brings it about that patients have constantly to readjust themselves to the ideas and personalities of new doctors, which is disastrous. Not only this, but it prevents the doctor from becoming thoroughly familiar with his cases. Under such conditions, thorough training, which is such an essential part of the treatment of tuberculosis, is impossible, and the soldier leaving the sanatorium is not so trained that he will be likely in his future life so to live that he can stay well.

Further, in army hospitals, if a patient is ambulant and not a permanent bed case he has no place where he can properly take the outdoor rest treatment. Unless he is working in the reconstruction department or is taking prescribed walks, his time is his own to be loafed around anywhere on ordinary chairs, in crowded assembly rooms or else on open unprotected porches where he is very sure not to go. This is not the ideal way for such patients to pass their spare time. If the government would supply them with rest pavilions, one for each thirty or forty men, with reclining chairs, wraps, a victrola, etc., in order that the men, when not doing reconstruction work or taking ordered exercise, might sit out together, they would begin to build up an esprit de corps, they could be visited and watched by their physicians, talked to and trained, and a healthy rivalry could be gotten up between adjoining pavilions as to which class took the cure best. Until some such system is developed in our army sanatoria it is not likely that it will be possible to get the results with these cases that can be had in private sanatoria despite the excellent personnel of the Army Medical service, which has charge of these cases.

The Army if possible should develop a corps of doctors whose whole work should be the treatment of tuberculous patients. The general doctor will never handle these cases in the way that they need. Further we must remember that the returned soldier is unfortunately an unusually difficult patient. He resists discipline, objects to the necessary orders and treatment, and is too often too unintelligent to grasp and carry out orders.

Dr. John D. Thomas: I am glad to hear Colonel Hoagland call attention to the psychological element in the treatment of tubercular cases, while at the same time giving it its proper valuation. It is often lost sight of both in private and sanatorium work.

Another feature that I am very much interested in is the reconstruction and vocational training work given these men while they are still under treatment.

I am connected with, as special medical adviser, and represent here the Federal Board for Vocational Rehabilitation and training of the disabled soldiers, sailors and marines. And we often find it difficult to properly place in business positions these tubercular cases, because we cannot judge their capabilities, physical and vocational.

But with the excellent training work being done at insitutions like Colonel Hoagland has told us about, it will be very much easier to place these men in gainful occupations, particularly if the institutions will note on the records they send them out with, the kind and degree of work given.

The work of the board is very large and very varied. We teach, train and place in remunerative positions any soldier, sailor or marine who has been injured in the service. Often it is difficult to accommodate the vocation to the injury, so that it is in just these cases the work of Colonel Hoagland and his staff are of inestimable value to us.

Colonel Bushnell: When I began to plan for the tuberculosis hospitals of the Army it was necessary at the onset to decide how large these institutions should be. I accordingly requested Dr. C. E. Edson, of Denver, to obtain for me the opinion of a number of the heads of tuberculosis sanatoria as to the best size of a sanatorium. Naturally there was no agreement as to the exact number of beds, but in general a small institution not to exceed say 200 to 250 beds was considered by all who were consulted to be better than those of much greater capacity. Although this opinion coincided with my own, circumstances compelled me not to follow the advice which I had sought, considerations of ease of management, reduction of "overhead" expenses and the scarcity of experienced administrators governing my decision. Of course the great objection to a large institution for the treatment of tuberculosis is the loss of the personal touch with the individual patients. A large institution that depends for its

success upon the personal relations with a single physician is foredoomed to failure. The paper of Colonel Hoagland is of especial value as showing how this difficulty was met and overcome in practice. As Colonel Hoagland has stated the hospital at Oteen was divided into sections, each section being commanded by a captain who was in charge of three or four wards, each of which was directly conducted by a lieutenant. The hospital was thus divided into a group of sanatoria the captains who commanded sections being equivalent to the chiefs of sanatoria with some 200 to 300 beds. It was easy for the commanding officer and the chief of the medical service to keep in touch with the chiefs of sections and to some extent with the other officers of sections, but the direct personal contact with the patients came mostly through the chiefs of sections and their subordinates. Such a plan demands a high degree of excellence in the chiefs of sections. Fortunately the character of the staff at Oteen is such that the method under Colonel Hoagland's able management has been very successful. Colonel Hoagland's paper therefore is not only an interesting report as to the management of a large tuberculosis hospital but an illustration of the way in which such institutions should be conducted.

THE ARMY TUBERCULOSIS PROBLEM AS SEEN IN MASSACHUSETTS.

By DR. JOHN B. HAWES, 2d,

BOSTON, MASS.

According to the latest figures that I have been able to obtain, dated May 19, 1919, there were 1,604 Massachusetts men, during the years 1917, 1918 and part of 1919, either rejected under the selective service law of the draft, or discharged from the various camps, on account of tuberculosis. In order to get information as to how much of a problem, as far as the State of Massachusetts was concerned, there existed in regard to these men, I made detailed personal inquiry of each of the local boards of health throughout the State. The State Department of Health has confirmed these figures thus obtained, while from the Massachusetts Red Cross I have received further help, and finally from the office of the Surgeon General at Washington I have received additional figures. From various private sanatoria, and other institutions, I have obtained facts bearing on the case. My own investigations do not cover the entire State, as sufficient time has not yet elapsed to allow of the collection of up-to-date figures in every locality. I have, however, fairly accurate knowledge from *all* the cities of Massachusetts, and *eleven* of the largest towns, amounting to over 90 per cent. of the total population.

From this group of towns and cities there were 1,566 men rejected by local draft boards, concerning whom I have some information. Many of these men, of course, were known to be tuberculous to local authorities before they were drafted, and their rejection was but a matter of form; a considerable number, however, were new cases. There were 491 who were definitely stamped as cases of tuberculosis by local draft boards, the re-

mainder being classified as suspicious, sufficiently so to call for their rejection. At the present time there are 548 out of these 1,566 men concerning whom local authorities can give no information. These men have either left the State, or have gone to some other locality, or, as is more apt to be the case, there has been no thorough or energetic search to find out what has become of them. 110 of the original number have died. Of 622 men, concerning whom I have fairly definite information, 500, something over 80 per cent., are working and apparently in good condition; 431 of these are under supervision by local authorities; there are 28 who are known to be working and in poor condition, and 43 are at the various sanatoria, state, county, and municipal. I have been able to discover only 42 Massachusetts men who have been discharged from the Service on account of tuberculosis. Of these 42, 29 are under supervision, either at home or in local or private sanatoria, and 11 are in state sanatoria. Here then is a group of 1,566 men of whom 491 (30 per cent.) are definitely called tuberculous, 548 (35 per cent.) have disappeared, while the others are called "suspicious cases."

In looking over these figures I at once asked myself the questions, "What constitutes a *war* tuberculosis problem from the point of view of the State and is a *war* tuberculosis problem in any way different from a peace tuberculosis problem?" I cannot see that it is. The war with its wholesale examination of men coming under the draft age has undoubtedly called to our attention many hitherto undiscovered tuberculosis cases, latent or active. It has done this in the same way that any survey properly carried out would do; in Massachusetts the results of the surveys of Barnstable County and of the cities of New Bedford and Cambridge, as well as the intensive work in Framingham, have shown that there exists, and probably always will exist a certain number of cases of tuberculosis which were hitherto unknown. I cannot see that the discovery of patients, the results of an examination carried on as a war measure, in any way differs from the results of similar work carried on in peace time or by civilian authorities.

As far as the men discharged from the Army for tuberculosis are concerned here again, except in the comparatively few cases handled by the War Risk Insurance Bureau, the State of Massachusetts has little if anything to do with the matter. Such men are automatically sent to Fort Bayard or to some other army sanatorium and are kept there until their future is assured one way or the other. Soldiers coming under the War Risk Insurance Bureau have been handled so simply and so easily in Massachusetts as to constitute no problem whatsoever. In a talk two days ago with the chief of the Massachusetts Red Cross I was given definite assurance, and permission to quote the statement, that from the point of view of the Red Cross in Massachusetts there has not been the slightest difficulty in handling the tuberculous soldiers or their families coming under the supervision of that organization. Some time ago I assured the Red Cross authorities that I would guarantee to place in some suitable institution within twenty-four hours notice any patient they might ask me to handle. I have had no difficulty in so doing.

There are, however, certain situations which have arisen as a result of the war which we did not realize to have existed before. For instance, the Red Cross assured me that the chief problem it had to meet as far as tuberculosis was concerned was not the question of available beds in sanatoria or hospitals for their patients, but how to get the knowledge to local authorities, whether boards of health or Red Cross representatives, as to how to take advantage of these vacant beds and of other means of disposal already available. It has certainly impressed on me, for instance, that it is important for any State, as a part of its method of handling tuberculosis to publish a bulletin at least once a year, and to see that such a bulletin receives the widest publicity and is couched in the simplest and plainest language concerning the facilities not only for diagnosis and treatment, but for the disposal of tuberculous patients within its borders. I thought that we had sent out such bulletins often enough and I

felt sure that the majority of physicians, and that certainly all boards of health knew how to get a patient into a state sanatorium, or at least knew how to get a patient into a local institution, or that they certainly knew where to apply for such information. I have come to realize, however, from my experience in the past year that I was mistaken, and that nothing along this line must be taken for granted. This is one point, and not a minor one, which may be called a war tuberculosis problem that awaits solution in Massachusetts.

In the figures, which I have already given, I noted with interest, and I must say with disappointment, the large number of men rejected under the draft classified as a result of my own investigations as "unknown," "disappeared," "left the state," or "removed." Here is another war tuberculosis problem. It ought *not* to be as simple as it apparently is, for a man who has been classified as tuberculous, or a tuberculosis suspect, to so utterly disappear that no trace of him, from the health point of view, is left behind. This I feel is a very definite problem. I believe the time is coming when each local board of health must make a yearly survey of the community of which it is in charge and give an adequate and satisfactory accounting of the present condition and the disposal of the cases of tuberculosis in its midst. Such a regulation, with a proper penalty clause attached, would, I feel sure, have a very salutary effect particularly on certain communities who pride themselves on being so healthy that they have no tuberculosis.

There *is* one problem, however, which the war has brought out which I feel must be met by every state and which affects every one of us. This problem is to find out how many of these men rejected in the draft, and discharged from the Army on account of tuberculosis, who, at the present time are definitely stamped as having tuberculosis or, which is perhaps worse, as *suspected* of having tuberculosis, really have that disease in the clinical sense. This I feel is a really important problem.

Two or three weeks ago I was asked to see a man in the

Out-patient Department of the Massachusetts General Hospital. He was 45 years old, a boiler maker, weighing nearly 200 pounds and looked a picture of health. He had a wife and five children and lived in a nearby city. He was taken with influenza while in service in the Navy in Ireland last October. During this time he had several copious hemorrhages. As soon as transportation could be arranged he was sent to the navy tuberculosis sanatorium at Las Animas, Col.; from there he had recently been sent back to his home in Massachusetts, and directed to apply to the Vocational Training Board in Boston for further help. He was examined by this board and was declared still to have active tuberculosis, and was told to go back to Colorado. It was at this stage that he saw me. According to the x-ray examination taken at the Massachusetts General Hospital there was no evidence of tuberculosis in this man's lungs; his temperature and pulse taken for a week at home were normal; sputum examinations were, and had been always repeatedly negative, and I personally could find nothing wrong with his lungs at any examination. I advised him to go back to work, and to keep under observation once a month, which he has done. There are many such cases as this in Massachusetts. I fully realize that the standards of diagnosis for tuberculosis, as far as the Army is concerned, must be and should be stricter perhaps than those we employ in civil life. A man may be discharged from the Army on a diagnosis based on the x-ray examination alone, and a man may be discharged for a slight hemorrhage which may or may not be due to tuberculosis. The Army could and should afford to take no chances.

I do feel, however, that the real tuberculosis problem which we have in the state of Massachusetts is not merely the looking up of those cases who have been classified as having disappeared or removed or unknown; it is not merely seeing that in the future every local board of health, and every physician, and every agent in the State dealing with tuberculosis, has accurate, up-to-date, knowledge of the facilities at his disposal, but that our

real problem which the war has given us is to find out how many of these men discharged from the Army, or rejected in the draft, on account of tuberculosis, really have that disease, and of more importance still, to formulate our standards so that there will be in the future a clear and definite understanding as to what constitutes active, pulmonary tuberculosis from the state and board of health point of view.

In a recent letter to a member of this Society, General Edwards, commanding officer of the twenty-sixth Division, in a reply to a question as to how much of a tuberculosis problem he had with his men in France, replied definitely that he had no tuberculosis problem. The Red Cross has assured me that they have had no tuberculosis problem. From the point of view of a State health officer dealing with tuberculosis, I can state that Massachusetts has no tuberculosis problem as far as handling and disposing of the individual case is concerned. I do feel, however, that the war has emphasized and called to our attention the problem which we already had with us, as to how best to come to some practical and sane conclusions and to formulate definite standards in regard to tuberculosis, its diagnosis and treatment. This it seems to me is the real Massachusetts war tuberculosis problem.

DISCUSSION.

Dr. James M. Anders: I desire to direct brief attention to certain physical signs of encapsulated pus. The late Dr. Musser emphasized the value of tenderness to palpation directly over these small collections. To obtain this sign it is necessary to use only the tip of the index finger, and to press firmly. This sign is often accompanied by a friction-rub over the corresponding area. The sign referred to suggests both the fact of abscess and its location. It affords ground for strong suspicion and should invariably lead to an exploratory puncture. Strangely enough this simple procedure is not resorted to with that degree of frequency which its practical importance demands.

THE TREATMENT OF TUBERCULOSIS IN RETURNED CANADIAN TROOPS.

By DR. J. RODDICK BYERS,

Medical Superintendent of the Laurentian Sanatorium and the Laurentide Inn Sanatorium, Ste. Agathe des Monts, P. Q., Canada.

THE treatment of tuberculosis in the returned Canadian troops devolves upon the Department of the Soldiers Civil Reëstablishment of Canada, created by Act of Parliment which conferred upon the Minister of the Department, the management and control of all matters relating to the reëstablishment of in civil life and activities, of all persons who have served in the Naval, or Military forces of His Majesty, or any of His Majesty's allies during the present war, and the dependents of such persons, and the administration of any statutes, or any regulations or orders enacted or made by the Governor in Council for such purpose.

It will thus be seen that, a very full authority has been given this department, and a study of the details of its powers shows it to be one of the most complete and competent organizations for the care, welfare, protection, education, and treatment of, not only the tuberculous soldiers, but of all casualties which come under its administration.

To enter into a detailed discription of the organization of the Department of the Soldiers Civil Reëstablishment would prove too great a task to be undertaken in the scope of this paper, but as far as the treatment of the tuberculous troops are concerned, the following are responsible.

1. Headquarter Medical Staff: Director of Medical Services, Deputy Director of Medical Services, Inspector of Medical Services, Officer i/c Medical Supplies and Equipment. (2) Unit Medical Staff: Unit Medical Director and two more assistants, specialist for examinations of the lungs, specialist for eye, ear, nose, and throat, surgeon, physician and others. (3) The

sanatorium staff as outlined later. (4) medical representatives: physicians in outlying places who represent the unit medical director in taking care of odd cases who might be living at home.

In addition it must be remembered that the medical branch of the department can when necessary and with authority granted call upon all other branches such as the engineering branch, purchasing, etc., for the necessary assistance and equipment of its institutions which tend for the welfare of the patients.

For the purpose of administration the country has been divided into geographical areas, termed "units" which are administered by officers representing the heads of the various departments, thus establishing the chain of responsibility between the sanatorium, hospital, and the Minister of the Department. As far as possible all "unit" officers have their business quarters in a common building so that ease of communication may be had and efficiency result. In this way delay in dealing with a soldier is reduced to the minimum.

At the moment of writing there are 9 "units" extending from Atlantic to the Pacific Ocean in which are established 29 sanatoria having a total capacity of 1,811 beds, and in which were 1,730 cases of tuberculosis under treatment on March 31, 1919. From the beginning of the war a total of 5,831 cases have been treated with excellent clinical results which are to be shown later.

Having outlined the organization of this important department, we will consider the case of an individual soldier suffering with tuberculosis. It matters not when or where the soldier showed symptoms of active disease, whether at the front or on home service: it matters not if he had active disease at some time before enlistment: the country accepted him in much the same way as an insurance company accepts a risk. The man offered his services, the country accepted them when he enlisted and now holds itself responsible for his welfare, and is determined to see to it that his treatment shall be complete and that he shall receive full compensation for any disability that may exist after treatment, as a result of his service in war.

No time is lost in discharging the tuberculous soldiers from the army, whereupon, and even while waiting for the formalities to be completed, he is attached to the department of the Soldiers Civil Reëstablishment for treatment, and immediately (after a short furlough home, if just arrived from overseas) is admitted to a sanatorium situated in the unit in which he enlisted.

While under treatment, to which there is no limit, he receives the same pay as if he were in the army and the equivalent amount received by his dependents while he was on active service is now paid to them. In this way and especially in the case of a married man, the mind is put at rest as regards financial burdens which would otherwise arise were not this very satisfactory arrangment in force. By producing this tranquility of mind, one of the chief points in treatment has been affected, as it would appear to be impossible for any married man, more especially a returned soldier, to settle down to the routine of a "rest cure," if his already too overwrought brain were to be worried by financial and domestic troubles.

The soldier, then, is offered a full course of sanatorium treatment, with the object of obtaining at least an apparent arrest of his disease, and testing out his resistance by suitable exercise before discharge from treatment is effected. He is not, however, forced to take treatment, for after all he is now a civilian and has his rights as such. He may therefore, if he desire, refuse treatment, but in doing so naturally resumes the responsibility and the government can only reckon his disability on a problematic basis as to what it might have been had he accepted treatment. It is therefore so greatly to the soldier's advantage to take treatment, that he seldom refuses until it has been given a trial, and once under treatment usually completes the course to the satisfaction of the department and himself.

While under treatment a patient may at any time upon recommendation of the sanatorium medical superintendent, and subject to the approval of the director of medical services, be transferred from one sanatorium to another, if, in the opinion

of the medical officer, the change would prove beneficial to the patient's health. Canada in its vast extent offers a board range of climate and altitude, and in this way, for instance, a patient who had asthmatic tendencies while under treatment in a sea-level sanatorium, might be benefited by a change to a more inland climate; and likewise, a patient with cardiac distress while in a mountain sanatorium might be equally helped by a change to sea level. These transfers are naturally all effected within the department, which takes all responsibility for the transportation and attendance on the journey.

And finally, the general treatment having been completed, by the soldier's disease having been proved to be "apparently arrested," he is discharged from treatment, and, first, passes under his own control and receives a pension on a basis of 100 per cent. disability, for the first six months after leaving treatment. At the expiration of this period he is reëxamined and his pensionable disability estimated by a board of medical experts under the Board of Pension Commissioners. Or second, he becomes a class 1 "out patient" for observation purposes, receiving his pay and allowances as if in the sanatorium. As far as tuberculosis goes, very few enter this class and the conditions warranting it must be exceptional.

Following the sanatorium treatment, if it has been found that the occupation of the soldier prior to enlistment was of such a nature as to be unsuitable for a man with latent tuberculosis, and with the idea of avoiding relapse, a soldier may receive vocational training or reëducation along lines suitable to his condition under the guidance of the vocational training branch of the department. While taking vocational training, he is paid the equivalent of what he received while under treatment, with an amount for living allowance added. In selecting a course of reëducation, the help of the vocational training department is given him.

The department owns and operates 11 sanatoria, and has arrangements with 18 other sanatoria for the treatment of its

patients. In many cases it has made generous additions to these private concerns, and in every way bettered their status. Fifteen of these sanatoria are fitted with x-ray equipment, twelve have clinical laboratories, and twelve are administering occupational therapy.

The sanatoria in each unit are situated as a rule, within easy reach of the chief cities which are the principal sources of supply of patients. Thus transportation is reduced to minimum, and to the great benefit of the patient, and comfort of his family at home.

In each sanatorium the medical superintendent is in full charge, and is answerable to the unit medical director. He is supplied with a staff which is usually divided under the following headings: medical, nursing, dental, housekeeping, dietitians, administration, discipline and occupational.

Complete records are now kept upon standardized forms, and the necessary reports and returns pass at proper intervals to the higher offices, and from one institution to another as necessity requires. The rules and regulations of the sanatoria are for the most part based upon the teachings of the late Dr. Edward L. Trudeau and the Saranac Lake school, and have been thouroughly systematized throughout the country so that a patient passing from one sanatorium to another experiences little or no change in the methods of treatment of his disease, which tends to increase his confidence, and help him in his fight for renewed health.

Early in the course of the war it became very apparent to the Canadian Government that a serious problem arising from the tuberculous casualty had to be solved, not only from the point of view of treatment, but in retaining them under treatment, as these unfortunate men returning from the horrid scenes of war, disheartened by the cruel part fate had played them, nervous, and used to being constantly on the alert, some holding life cheap, assumed an indifference to their treatment and welfare to such an extent that approximately 48 per cent. refused treat-

ment in one sanatorium at least which at that time was being operated without regard to occupation of the mind, while the body remained at rest.

After making a careful analysis of this distressing state of affairs whereby practically 50 per cent. of the sanatorium patients found the treatment so devoid of interest as to refuse it and thus destroy their chances of recovery, it was decided that something must be done immediately to make the sanatorium treatment more attractive if the treatment of the tuberculous soldier was to prove a success, for without successful treatment first completed, it must fail.

As the result of a consultation between the medical and vocational training branches of the department, *occupational therapy* was introduced into the methods of treating lung disease, and the following classification of patients and occupations was arranged which with little variation from the original draft has been in use up to the present date.

Classification of Patients.

The patients are divided into three classes as follows:

Class A (*Infirmary Cases*).—Those patients who are suffering with the disease in the acute or toxic stage, and are, in consequence, confined to bed in the infirmary throughout the whole day, until all fever and distressing symptoms have subsided. These patients are allowed to knit, draw, embroider, crochet, do cardboard work, weave raffia, and study, all in moderation, and under strict clinical observation and control. The work is in no way obligatory, but, on the contrary, being planned with thought for the necessity for rest, it is used only so far as applicable to this end.

Class B (*Porch Cases*).—The patients in this class are allowed to attend the meal table three times daily, wash themselves and perform other daily habits, and rest in the open air in reclining chairs in the porches during the remainder of the day. They are kept under careful clinical observation and with the slightest

signs of toxæmia are immediately reverted to Class A until it has been ascertained that the condition is again quiescent. They are allowed to do more work of the same sort as given to Class A and, as they increase in strength, begin to undertake slightly heavier work, such as reed basketry, stenography, penmanship, telegraphy, and class study.

Class C (Exercise and Workshop Cases).—As the clinical evidences point to the disease becoming arrested, the patients pass into this class which is graduated into six subdivisions according to the periods of time allotted to exercise, *i.e.*, (1) fifteen minutes, (2) thirty minutes, (3) forty-five minutes, (4) one hour, (5) one and a half hours, (6) two hours; exercise twice daily.

By this, it must be understood that a man entering Class C is allowed 15 minutes slow walking, morning and afternoon; if he show further improvement he is advanced fortnightly into the succeeding divisions. This does not mean that the patient is actually taking the full amount of exercise, but he is allowed to be off his chair and to devote his time to exercising, visiting, and other pursuits.

Class C patients having reached the subdivisions, and having been prepared for manual occupation by light duty and walking exercises, report to the occupational training shop and are shown on the roster of their subdivision which is furnished daily to the instructor. While attending the shop they are given instruction in their choice of the following arts and crafts: cabinet and toy making, basketry, carving, modeling in clay, concrete and metal work, picture framing, illuminating, engraving, stenciling, weaving, design and drawing, lathe work, or they may instead of craft work, and under promise of completing a course of study, forego this and attend a class of instruction in the French of English language, or a course in general school instruction following the qualifications required by the civil service department of the Canadian Government.

In addition to the occupational routine and by way of education and at the same time entertainment, two moving picture

shows are provided each week, while at intervals concerts, lectures, and other forms of instruction are added to the great benefit of the patients.

In operating the system of occupational therapy the medical superintendent of the sanatorium is in full charge of every department and has a complete staff as follows: assistant medical officers who attend to medical details connected with the daily routine and who are furnished daily with reports on temperature, pulse, and respiration and other records furnished by the nurses on duty: an officer in charge of discipline who with his own assistants maintains order in the institution: a chief instructor who is in charge of the vocational and occupational training, and who is assisted by a ward work instructress and competent staff. In many instances the subordinate assistants are selected from Class C patients.

The classification of occupation and patients works automatically, as the physician after determining the patient's physical status, posts him to the officer in charge of discipline and to the instructor at the same time. Any delinquency on the part of a patient is reported to the officer in charge of discipline by the instructor, but as a rule this seldom occurs. If a patient report ill to the instructor, he is immediately excused from all occupation or study, and presents himself for examination, diagnosis and treatment by the physician when he is reclassified according to conditions presenting themselves.

The occupational shops and schools are designed so as to admit a maximum amount of light and sunshine on the south aspect of the building. The shops are furnished with carpenters' benches, lathes, band saws, wood planers, and mortice machines all operated by electric motors. These were installed in order to allow the hard woods being worked without danger to the delicate patients taking treatment, and minimize the danger of strain and consequent relapse.

The instruction given to Class A and B patients is given at the bedside, in the case of an infirmary patient, or on the

rest galleries when the patient is allowed to sit out, and is demonstrated by a trained ward aide who is a member of the staff. Of course in these classes only the lightest forms of finger work is allowed.

In addition to occupational therapy, it must be understood that all medical and hospital details of a properly conducted sanatorium are carried out, and that the occupational therapy is an adjunct to the medical organization. As a result of the system there has been a reduction of insubordination from 15 per cent. to less than 1 per cent., while refusal of treatment has been reduced from 33 per cent. to practically zero, thus making a total increase of 48 per cent. taking full treatment since the introduction of occupation into the lives of these tuberculous patients. At the same time the actual clinical results have been equal to those obtained by the ordinary sanatorium methods as used in civilian sanatoria previous to the War.

Following discharge from the sanatorium the social workers follow up the patient and report at intervals on his welfare. Should relapse follow at any time he can be admitted immediately to sanatorium treatment, and again receive all the benefits of the institution. If the patient is well at the expiration of six months following discharge from the sanatorium, he then presents himself before the Board of Pension Commissioners for medical examination when his pensionable disability is estimated for a further period of six months.

The results* of treatment prepared up to March 31, 1919, show a most interesting record.

The total number of cases of pulmonary tuberculosis was 5,831, of which 3,614 were discharged, and 487 died, leaving 1,730 under treatment at the end of the year ending March 31, 1919. 72.9 per cent. of all men treated have been overseas, and 27.1 per cent. of all men treated have not been overseas. Of

* "History and Development of the Medical Branch, Department of Soldiers Civil Reëstablishment," by Lt.-Col. F. McKelvey Bell, *Med. Quarterly*, Dept. Soldiers Civil Reëstablishment, Vol. 1, No. 2.

those discharged, 12 per cent. had apparently arrested disease; 9.3 per cent. had quiescent disease; 41.5 per cent. showed marked improvement; 7.3 per cent. showed no improvement; 6.3 per cent. refused treatment; 4.6 per cent. cases were not tuberculous; 17 per cent. were not recorded; 2 per cent. were absent without leave. The percentage of deaths was 9.3 per cent.

THE DIAGNOSIS OF EMPYEMA.

By J. N. HALL,

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An occasional failure in the diagnosis of empyema is inevitable under the best of conditions, but, in general, failure to find a purulent collection within the chest is dependent upon lack of skilful and presistent employment of well-recognized methods of diagnosis. We shall consider some of the reasons why so many effusions were found by the pathologist rather than the clinician during the past two years.

In the first place the concentration in camps of many men, and more especially of young men from rural districts gave opportunity for the wide diffusion of acute respiratory infections, and at the same time for an increase in virulence of the causative organisms.

The resultant pneumonias and bronchopneumonias departed very widely from the usual types in time of peace. The unparalleled epidemic of 1918 added still further to the confusion.

During the epidemic of lobar pneumonia of the winter of 1917–18, many purulent effusions occurred as accompaniments rather than as sequelæ of the pulmonary consolidation. The solidified lung, often held by pleural adhesions, could neither collapse nor retreat before the effusion, which consequently spread as a thin layer around the periphery of the lung instead of accumulating as a pool of fluid in the pleural cavity. The consolidated lung gave a degree of flatness which was but little accentuated by the thin layer of fluid, and, unless the absence of vocal fremitus were noted, a physician of fair experience might well fail to suspect the effusion. In many cases but little displacement of the heart occurred. Thus, death not infrequently resulted from the pneumonia before the diagnosis of fluid was made.

Even if suspected, aspiration only too frequently failed to establish the presence of fluid. With so thin a layer, the needle easily passed through the effusion; suction filled the needle with the pneumonic exudate or with blood, and, believing it to be a "dry tap," the needle was withdrawn. The only sure method of establishing the true diagnosis in these cases was to insert the needle slowly, with a good vacuum provided as soon as the eye of the needle was safely through the skin. The few drops picked up as the needle passed in sufficed for the microscopic diagnosis if only properly examined.

Another source of error lay in the frequent presence of loculated, multiple effusions. If the needle demonstrated pus, and the cavity was drained surgically, there was the temptation to attribute any subsequent fever or other symptoms to the focus already found. Yet in fact, there were frequently two, three, or even four pockets of pus within the chest. I noted in one fatal case three separate pleural pockets, one on the right and two on the left, which we had found and drained; a pericardial empyema which we had aspirated, and yet a clear, serous effusion of three to four ounces was found at the left apex at autopsy.

In one case, following an alveolar abscess, pericarditis with effusion appeared. In three days we found a large effusion in the left pleura, more than a pint of clear, serous fluid being withdrawn on two separate occasions by aspiration below the left scapula. Finding evidence of fluid in front, we aspirated the pleural cavity near the left nipple, and found a clear serum similar to that previously found in the back but with a strong colon bacillus odor. Suspecting some more serious infection, we tried the next interspace below, and obtained a bloody serum with a similar odor. Still not satisfied, we went in lower down and found a stinking colon bacillus pus, with an added mixed infection. Through the opening made by resecting a rib for drainage, the surgeon felt the heart beating within its distended pericardium, thus confirming our diagnosis of pericarditis with effusion. As the patient recovered without further incident we are presumably

safe in assuming this to have been a simple, serous inflammatory fluid.

The danger of stopping with the finding of the first fluid in such a case is obvious. I have found two, three, or even four fluids in so many cases that I feel that there is no safety without the use of the needle in every suspicious area. When an infected exudate is found we must be prepared for secondary exudates either simple or infected, in the same serous cavity or some contiguous one.

In one case a chest half full of pus was overlooked because the temperature was constantly normal, and no search was made for it. The patient was recovering from typhoid fever with a complicating pneumonia, and I assume the absence of fever to have been comparable to that similar phenomenon,—post-febrile bradycardia, so frequently noted under these conditions. Prompt recovery followed drainage.

There is a curious type of empyema, of which I have seen four cases, in which diagnosis often failed before we had the help of the x-ray, and too frequently since. I refer to those cases in which the effusion gathers above the arch of the diaphragm without coming in contact with the periphery of the chest at any point. The abscess finally breaks through a bronchus, temporary recovery occurs, and physical examination remains entirely negative. The shadow of the fistulous track may show in the x-ray plate. One such probable case, under my observation had had some ten separate attacks in the course of thirty years, in which he coughed up about a pint of pus each time. It must have been a recurring pneumococcic suppuration, I judge, since the pus was so thick that he almost strangled to death on several occasions, yet made a practically complete though temporary recovery in the intervals.

During the winter of 1917–18, many bloody effusions occurred in connection with lobar pneumonia, and not, so far as I know, associated with any especial type of pneumococcus but frequently with the hemolytic streptococcus. The pericardium was in-

volved by this process as well as the pleura in certain instances. The effusion was so bloody as to suggest for an instant in one case that the heart had been punctured. These cases went rapidly on to suppuration, and I saw purulent pericarditis as well as several cases of pleural empyema develop in them. One might easily be deceived by assuming that such an effusion was likely to follow the course of the ordinary bloody, tuberculous or cancerous effusion. Repeated use of the exploring needle sufficed to determine the time when the effusion became really purulent.

Another cause of failure to find the empyema lay in the fact that the fluid was not infrequently coughed up, without attracting the attention of the too unsuspicious attendant. The disappearance of most of the physical signs and some of the symptoms led to the belief that the patient was doing well, and he passed from close observation. The thinner streptococcic fluids were more easily evacuated without knowledge of their presence than the thicker pneumococcic effusions. This was due in part at least to their quicker destructive effect upon tissues, so that they broke through before reaching the greater dimensions of the pneumococcic ones.

In the influenzal pneumonias the destructive effect of the influenza bacillus upon the bronchial mucosa so well described by Opie, and the pneumonia commission, led to the frequent interstitial emphysema and the less frequent pneumothorax as complications of influenzal pneumonia. Many of these complications came to my notice. I believe that the early evacuation of empyema through the bronchus must have been due in certain cases to the same organism. Thus, in one of our cases of lobar pneumonia, following influenza the fluid was demonstrated by aspiration on the fifth day in hospital. Drainage was postponed after consultation with the surgeon, but on the seventh day the pus broke through and was coughed up. I have seen many cases of empyema so evacuated but never another one so early as this.

Before the common use of the x-ray much confusion existed

in certain cases as to whether a purulent effusion was above or below the diaphragm. The exact location was frequently not positively determined until after the resection of a rib, although the proper conclusion was possible with care in a majority of cases. It is generally an easy matter with the use of the roentgenogram.

The danger of a subphrenic abscess beneath a neglected empyema must not be forgotten, although in my experience the transmission of the infection through the diaphragm in the contrary direction is at least twenty times as common. The possibility of a metastatic subphrenic abscess must not be overlooked.

A frequent source of error lies in assuming that an irritative, non-infected serous effusion, especially in the lower right pleural space, is the source of all the patient's symptoms, when in reality, to the initiated, it is merely the sign that beneath the diaphragm lies a suppurative focus which accounts for the greater fever, leucocytosis, and the generally severe symptoms. If not entirely satisfied that the character of the fluid obtained is in harmony with the general symptomatology of the case we must go further, and repeatedly test the neighboring dull area with the needle until the doubt is resolved. I have known of operations done for a non-existent empyema by fairly experienced men, because of failure to recognize that they were dealing with a subphrenic abscess with an infection of only a moderate degree of virulence which had broken through the diaphragm, both layers of pleura, and the lung, and been evacuated through a bronchus. These cases, especially the ones beginning in an ascending infection from a retrocecal appendix, occasionally diverge from their usual course in which the pus presents at the periphery of the chest, either as an anterior or a posterior intraperitoneal abscess, and go instead through the arch of the diaphragm, most frequently following up along the tissues of the right border of the mediastinum, and reaching a bronchus by this route. In one case the burrowing process led to a fistulous opening above the right clavicle, the track being visible in the roentgenogram. The presence of

gas bubbles was notable in this case, since it was a gaseous subphrenic abscess. In one of these cases two different surgeons had opened the right chest, wholly without warrant, believing that pus existed somewhere and hoping to find it by this route. Dr. H. R. McGraw finally found the sinus by searching in the region indicated, and drained it successfully, although the patient eventually died as a result of his year-long suppuration. In one of the camps I saw an exquisite roentgenogram showing a complete recovery from the rupture of subphrenic abscess upward through the lung. The subject had evidently recovered so fully as to be accepted for full army service. This must be extraordinarily unusual.

Many difficulties of diagnosis result from failure to recognize the different courses pursued by purulent collections in or about the liver, according to the character of the infection. To illustrate, let us take three different types of infection from within the abdomen, all eventually invading the thoracic cavity:

Type 1. Amebic Abscess.—The rule is, in the case of extension upward from the liver, for the slowly advancing process to fuse together the peritoneal, diaphragmatic and pleural layers so that the abscess, even when mixed infection has been superadded, develops in the tissue of the lung without the intervention of an empyema, and evacuation through a bronchus occurs. One must seek for the pus in the liver or the lung in these cases.

Type 2.—The common appendiceal subphrenic abscess should be found as soon as the fluid crowds up the diaphragm, commonly, of course, upon the right side. If any delay occurs there is imminent danger of perforation of the diaphragm, with empyema as a result. The more rapid advance of the destructive process in these acute cases gives less opportunity for the fusion of layers mentioned in the last paragraph. Only in sadly neglected cases, does such a virulent type of empyema escape detection, with perforation through the lung as the final result. I believe this rarely occurs excepting in cases in which the perforation of the diaphragm occurs rather centrally, so that the abscess is never in direct contact with the chest wall.

Type 3.—This is represented by the subdiaphragmatic suppuration resulting from the perforation of a gastric ulcer, in such a position that the lesser peritoneal cavity is invaded, and, with the added complication of escape of gas from the digestive tract. The process is a rather rapid one. I have several times seen a secondary effusion in the left pleural cavity, originating by transmission through, but without gross perforation of the diaphragm, and I know of no more difficult task than the correct interpretation of the physical findings in such cases. The resonance of the lung, that of the stomach, that of the air-containing lesser peritoneal cavity, and the dulness due to the exudate make a most complicated problem. The x-ray is of decisive weight in these difficult cases. I have known the effusion, without mixed infection, of a tuberculous pyopneumothorax to be mistaken for an empyema and treated by drainage with resulting fatal secondary infection.

In three instances I noted the error of diagnosing abscess of the lung in a case of recognized empyema of the right pleura, already drained, when the purulent collection was in fact an interlobar empyema, pocketed in each instance, in the upper fissure on the right side. In each case the pus had been found by aspiration; one recovering without further intervention, the other two requiring drainage. The favorite location of such effusions is deep in the fissure, so that no absolute flatness to percussion was to be noted in these cases. No elastic tissue was found in the scanty sputum of either case nor in the fluid withdrawn. The full recovery, as in simple empyema, in each of the cases suffices, in my opinion, to exclude the more serious lung abscess.

In one case of hemolytic streptococcus bronchopneumonia in my service, a diagnosis was made of a mediastinal abscess from breaking down of the infected and enormously swollen tracheobronchial glands, which had previously blocked the right bronchus by pressure, as demonstrated at the clinic. I missed a later purulent pericardial effusion in this case, resulting from a

breaking through of the infection into that serous cavity. Other similar instances of pressure by or suppuration of these glands were noted.

I have neither seen nor learned of a case of pulsating empyema nor of empyema necessitatis during the past two years.

It is elementary but necessary to speak of using a needle of at least a millimeter in internal diameter, and six or eight centimeters in length. Many an empyema was missed by not going deep enough for it, or by going in the wrong direction. I saw many cases of failure because of insertion of the needle so low in the back that either the point penetrated the liver, or more commonly the tapering wedge-shaped complementary pleural space. This was either so thin that the needle passed through it or the effusion was so thick, or so much replaced by fibrinous sedimentary deposit that a dry tap resulted.

I have seen failure to make the diagnosis of a purulent exudate because the needle was inserted so high that the supernatant serum was withdrawn, appearing so clear to the naked eye that a serous effusion was diagnosed. No careful examiner could possibly be deceived in this way since the pus cells evident at the first glance through the microscope would have settled the diagnosis.

No more important lesson is to be derived from the study of these cases than that the needle must be more freely used. The feeling amongst the younger men especially, that to fail to find fluid with the needle is a reflection upon their skill, must be overcome. The needle must be used in the face of the unfavorable signs and symptoms noted above, until one is satisfied that no collection of fluid has escaped detection. The fact that only impaired resonance is present, as has so frequently been the case in the effusions in the upper fissure of the right lung must not deter us. One must pass through lung tissue to find the pus in many instances. If one finds fluid in more than perhaps a third or a quarter of the taps made, he is not using the needle often enough. He may save himself from some embarrassment,

but he will certainly lose some of his patients. After one of my cases had been repeatedly but unsuccessfully aspirated in two other hospitals and finally lost sixty pounds in weight, we found his empyema on the thirteenth puncture and restored him to health. The "dry tap" bogie must go.

I have mentioned the many possibilities in the various cases quoted to call the attention of the members of this association to the need of our attempting in our clinics, our lectures and our writings, to promote a wider diffusion of the knowledge we possess regarding effusions in the chest. I fear that we assume that the new graduate is more familiar with this vast subject than he really is, even though he has had a good hospital interneship. Only by constantly presenting the subject to the profession can we make sure that these effusions will be generally recognized at such an early date as to enable the patient to obtain the full benefit of the necessary treatment.

END RESULTS OF EMPLOYMENT OF EX-PATIENTS IN SANATORIA FOR TUBERCULOSIS.

By HARRY LEE BARNES, M.D.,

WALLUM LAKE, R. I.

The problem of finding employment best suited for tuberculosis patients whose disease has undergone arrest has long been perplexing and it is my object to show the results of employing discharged patients in the sanatorium itself. The material on which this article is based was obtained from the subsequent histories of 286 patients who were employed in the State Sanatorium at Wallum Lake, R. I., during the years 1906 to 1919 inclusive. At the outset the initiative for employment came largely from the patients themselves. They felt able to work and in most cases they had to work somewhere speedily in order to support themselves or their families and they wished to work where they had regained their health. Before discharge, patients whose disease was undergoing arrest were put on graduated exercise and work gradually increasing to a maximum of four and one half hours work daily. In most cases this work was more or less similar to the work later given them as employees. After employment, the daily hours of work were eight for domestics, eight and one half for nurses, and nine for outside laborers. Comparatively few, less than ten per cent. of our patients were considered fit to do outside work like shovelling coal, carting freight, ploughing or any work requiring heavy lifting.

As a rule, the application of all patients for work was refused unless it was believed that their physical condition fully warranted it, but in about a dozen instances the economic necessity for work was imperative and as it was merely a question of whether the patient should work with us or others, we reluctantly ran the risk. Some of these patients succeeded and some

failed. From the standpoint of the institution, the chief disadvantage of employing patients is the danger of relapse. The number of patients who relapsed during the time of their first employment at the sanatorium was 60 or about 21 per cent. Many others subsequently tried other employments, relapsed and were reëmployed by us. While it is an unquestionable disadvantage to have employees, 21 per cent. of which will relapse with tuberculosis, this is more than counter balanced by the advantages of knowing the character and ability of employees before hiring them and by the opportunity of quickly filling vacancies from the resident population.

The proportion of patients who will relapse on such a scheme will of course depend on the judgment of the physician who selects the patients for employment and the severity of the work assigned them. While we selected our patients carefully to exclude active cases, most of them were in the moderately advanced stage and 190 or 66 per cent. of the whole number had had tubercle bacilli in the sputum at some time previously. The percentage of all sanatorium employees on the payroll in the month of January of each year who have had tuberculosis is shown in Table I to have increased from almost none in 1905 to 80 per cent. in 1919.

TABLE I.

The positions occupied by our patients are difficult to classify, as many were employed in more than one position but an idea of their work may be obtained by Table II.

TABLE II.

Positions of Employees.

Waiters	126
Nurses	40
Outside workers	24
Housework (mainly cleaning)	22
Orderlies	12
Laundry	8
Assistant carpenter	8
Substitutes	8
Storeroom	5
Miscellaneous	33
Total	286

The end results of all patients employed, classified according to the year they entered our employ is shown in Table III. Patients discharged before the fall of 1917 are shown as their condition was reported at that time. Patients employed since 1917 have their condition recorded as it was in May, 1919.

In Table II the end results of those who had had positive sputum are compared with those whose sputum had never been found positive.

TABLE IV.

	Cases.	T. B. + or −.	Cases.	Living.	Dead.	Unknown.
Apparently cured	38	+	18 = 47%	14 = 77%	3 = 16%	1 = 5%
		−	20 = 52%	19 = 95%	.....	1 = 5%
Arrested	96	+	62 = 64%	32 = 51%	28 = 45%	2 = 3%
		−	34 = 35%	24 = 70%	4 = 11%	6 = 17%
Apparently arrested	19	+	7 = 36%	5 = 71%	1 = 14%	1 = 14%
		−	12 = 63%	11 = 91%	.....	1 = 8%
Quiescent	84	+	68 = 80%	51 = 75%	17 = 25%	.....
		−	16 = 19%	15 = 93%	1 = 6%	.....
Improved	34	+	23 = 67%	14 = 60%	9 = 39%	.....
		−	11 = 32%	10 = 90%	1 = 9%	.....
Unimproved	15	+	12 = 80%	4 = 33%	7 = 58%	1 = 8%
		−	3 = 20%	2 = 66%	1 = 33%	.....
Totals	286	+	190 = 66%	120 = 63%	65 = 34%	5 = 2%
		−	96 = 33%	81 = 84%	7 = 7%	8 = 8%
Combined totals	286	.....	286	201 = 70%	72 = 25%	13 = 4%

TABLE III.

Condition, Fall 1917 for Patients Discharged Previous to 1917 and Present Condition of Those Discharged Since.

	1906.				1907.				1908.				1909.				1910.				1911.				1912.			
	Well.	Living.	Dead.	Unknown.	Well.	Living.	Dead.	Unknown.	Well.	Living.	Dead.	Unknown.	Well.	Living.	Dead.	Unknown.	Well.	Living.	Dead.	Unknown.	Well.	Living.	Dead.	Unknown.	Well.	Living.	Dead.	Unknown.
Apparently cured	4	2	..	..	..	..	..	1	5	1	..	..	6	1	..	..	3	..	..	1	2	3	1	..	6	..	1	..
Arrested	3	1	6	..	2	..	3	2	3	..	4	1	3	1	5	..	4	1	7	1	2	2	1	1	5	3	6	1
Apparently arrested	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Quiescent	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Improved	..	..	..	..	..	..	2	..	..	..	4	..	..	1	..	..	..	2	..	..	1	..	1	..	..	2	..	..
Unimproved	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..
Totals	7	3	6	..	2	1	6	3	8	1	8	1	9	3	5	..	7	3	7	2	5	5	4	1	11	6	7	1

	1913.				1914.				1915.				1916.				1917.				1918.				1919.			
Apparently cured	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
Arrested	2	..	..	1	2	1	..	..	4	..	..	..	..	2	..	..	8	..	1	..	..	7	..	..	..	..	..	..
Apparently arrested	1	..	..	..	1	..	..	..	..	..	..	..	..	3	..	..	2	1	1	..	..	8	..	1	..	1	..	..
Quiescent	1	2	4	..	3	4	3	..	3	4	2	..	..	9	2	..	19	6	..	..	1	16	1	..	..	4	..	..
Improved	..	1	..	..	..	1	..	..	1	2	..	..	..	..	..	..	3	1	..	..	..	10	2	..	..	..	..	..
Unimproved	..	..	1	..	..	..	1	..	..	..	..	..	..	2	..	..	1	3	..	..	..	1	1	1	..	..	..	..
Totals	4	3	5	1	6	6	4	..	8	6	2	..	..	16	2	..	33	12	2	..	1	42	4	2	..	5	..	..

Grand Totals.

	Well.	Living.	Dead.	Unknown.
Apparently cured	26	7	3	2
Arrested	30	26	32	8
Apparently arrested	2	14	1	2
Quiescent	8	58	18	..
Improved	2	22	10	..
Unimproved	..	6	8	1
Totals	68	133	72	13

The comparison of results in each year between those employed at the sanatorium and those who were employed elsewhere in those discharged as cured, arrested, apparently arrested and quiescent, is shown in Table V.

TABLE V.

Year.	Employed at Sanatorium.			Not Employed at Sanatorium.		
	Cases Known to be Living.	All Cases.	Percentage Known Living.	Cases Known to be Living.	All Cases.	Percentage Known Living.
1906	10	16	62	25	67	37
1907	2	8	25	24	78	30
1908	9	13	69	39	86	45
1909	11	16	68	56	178	47
1910	8	17	47	58	101	57
1911	9	13	69	61	99	61
1912	14	22	63	46	85	54
1913	6	11	54	56	73	76
1914	11	14	78	33	53	62
1915	11	13	84	46	69	66
1916	14	16	87	96	110	87

From the above table, it appears that the employees made a better showing in seven out of the eleven years, an equal showing one year and a worse showing in three years.

In Table VI the end results of those who were employed by us are compared with end results of those who were employed elsewhere according to the condition on discharge.

TABLE VI.

CONDITION JANUARY 1, 1918, OF PATIENTS DISCHARGED BEFORE JANUARY 1, 1917.

Condition on Discharge.	Patients Employed at Sanatorium.				Patients Not Employed at Sanatorium.			
	Living.	Dead.	Unknown.	Per Cent. Living.	Living.	Dead.	Unknown.	Per Cent. Living.
Apparently cured ...	30	3	1	88	63	15	17	72
Arrested	43	29	4	56	253	248	52	45
Apparently arrested.	7	.....	.....	100	40	6	3	81
Quiescent	29	10	.....	74	145	60	16	65
Improved	10	7	.....	58	350	622	80	33
Unimproved	4	4	.....	50	84	803	29	9
Totals	123	53	5	67	955	1,754	197	51

In order that the report may be complete, in Table VI the cases discharged improved and unimproved have been included. The improved cases who were employed were mostly cases that lacked a few days of being classified as quiescent. The few cases who were employed as unimproved were cases that had previously been much improved or even quiescent and who were employed so soon after re-admission that they could only be called unimproved on their discharge to enter our employ. It would not be fair to compare these cases with the great body of patients discharged from the sanatorium as improved or unimproved. If these two classes are excluded, we find that 109 or 69 per cent. of 156 patients employed by us were known to be living, while 521 or only 55 per cent. of similar groups not employed by us was known to be living. While the 286 cases here presented is not a sufficient number to accurately fix the recovery rate, it is suggestive and should stimulate others to collect statistics bearing on this point. Of course, many fathers and mothers of families, or high-priced workmen considering all their problems, may be warranted in returning to their old occupations, but there remains a large percentage of unmarried under thirty years of age who have no occupation which is specially remunerative and can well afford to spend a year or two working in sanatoria if it enhances their recovery rate.

Even though employment in sanatoria did not prolong the life of patients, it would yet be wise to give them preference in employment in order that money provided for fighting tuberculosis might so far as possible go to those who have suffered from the disease. When it can be shown that it does prolong life it is even more incumbent on institutions for tuberculosis to employ ex-patients.

The advantages of an employment bureau for tuberculosis patients fit to work, conducted by the National Tuberculosis Association or some other charitable organization, are obvious. Such a bureau would supply the lack of applicants for certain positions in one sanatorium by the excess of applicants for this position in other sanatoria.

Conclusions.

1. In groups of patients whose disease was at least quiescent on discharge observed for periods varying from two to thirteen years, 69 per cent. of those employed at the sanatorium survived against 55 per cent. of those not employed at the sanatorium.

2. Patients ought to obtain work in sanatoria if possible as it increases their chance of survival by about 25 per cent.

3. Sanatoria ought to employ patients whose disease has become arrested or quiescent in preference to healthy persons as it increases the number saved.

4. There should be an employment bureau for finding positions for ex-patients in sanatoria.

DISCUSSION.

Major E. O. Otis: I cannot speak from very much experience in the employment of ex-patients in sanatoria, the way Dr. Barnes has done, although I had some opportunity for observation while visiting physician at the Rutland (Mass.) Sanatorium. It is my feeling that as a rule it is better to return arrested cases to their usual and accustomed environments and social statue so that they may as soon as may be resume their previous occupation unless of course, this happens to be an unwholesome one. Of course there are exceptions, where it is obviously safer to retain in the sanatorium as an employee an arrested case; for example a patient, may have no home and no means, and if sent away would in evitably be obliged to drift about under unfavorable conditions, while looking for a job. On the other hand many patients do not find sanatorium life agreeable and are only too happy to foresake it as soon as their condition permits.

So that from one reason or another, there would not be very many patients, it seems to me who would from choice remain in the sanatorium as employees. Undoubtedly many or some cases would obtain a more perfect arrest and maintain it more permanently, as indeed Dr. Barnes has shown, if they would or could take this post-sanatorium course as employees. Dr. Barnes is to be congratulated upon his success, but one must remember that he had the advantage of careful and continued observation of these former patient-employees and could select those whom his experience had shown were good risks.

OBSERVATIONS ON THE EPIDEMIC OF INFLUENZA OCCURRING IN THE U. S. NAVAL HOSPITALS IN PHILADELPHIA IN 1918.

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These observations are based upon a study of the more serious of about three thousand cases of influenza occurring among the officers and men in the U. S. Navy in Philadelphia. Most of the patients were between the ages of twenty and twenty-six years and were in unusually good physical condition.

Influenza appeared in the British Army in May, 1918, and was brought to Philadelphia by ship. The first case of influenza was diagnosed on September 12, 1918, at the U. S. Naval Hospital, League Island, unrecognized cases having occurred earlier. At first the epidemic resembled that of 1889–90, but quickly marked differences were observed, such as a greater toxicity and mortality, susceptibility of young adults, and partial or complete immunity of those past middle age.

The epidemic was characterized by extreme contagiousness, rapid onset, early and rapidly developing adynamia, cyanosis and a high rate of mortality. The period of incubation averaged from one to four days.

The U. S. S. "West Gaylock" sailed from an uninfected port in California, arriving at the Philadelphia Navy Yard on November 19, 1918. Although the epidemic was subsiding, 35 men were admitted to the U. S. Naval Hospital with influenza differing in no respects from cases observed during the height of the epidemic in October. This observation opposes the theory that the virulency of influenza diminishes at the end of an epidemic, and supports the idea that the disease disappears because most non-immunes have been infected.

Influenza may be clinically classified as mild, ordinary, severe or toxic. The toxic variety may be subdivided into pulmonary, circulatory, nervous, gastro-intestinal and renal.

A typical example of mild influenza occurred in a sixteen-year-old girl, who was suddenly seized with headache, backache, pains in the extremities, malaise and attacks of slight or moderate perspiration, occurring two or three times daily. In the beginning the cough was slight, infrequent, dry, later becoming more frequent and accompanied by a small amount of mucopurulent sputum, containing many influenza bacilli. Auscultation revealed a few dry bronchitic râles in both lungs, and an extremely feeble respiratory murmur at both bases. The muscular element of the first sound of the heart was extremely weak, and this organ did not react to the stimulating effect of fever. The pulse was easily extinguished by slight pressure and was less frequent than the fever would indicate; the systolic and diastolic pressures were low and the pulse pressure large. The fever lasted but a day, coryza and sneezing were absent, the eyes were unusually brilliant and the vessels of the ocular conjunctivæ injected. During the first four or five days the only symptoms complained of were headache, backache, weakness, frequent attacks of moderate perspiration, diminished appetite and constipation. The urine showed no important change. Despite these few symptoms and the brief duration of fever, weakness continued, necessitating rest in bed for ten days. On the tenth day extreme fatigue was caused by sitting up for thirty minutes. Two weeks later the patient was improved, but weak and required two weeks rest at the seashore before complete recovery was secured. This case typifies an extremely mild influenzal infection, with ephemeral fever occurring in one previously healthy and illustrates the severity of the toxemia in a mild case of influenza.

Ordinary Influenza presented the same symptoms and signs as mild influenza, excepting that the fever, usually remittent in type, continues for four or more days, the pain in the head and

extremities is more severe, cheeks more flushed, conjunctival vessels more injected, eyes brilliant, exhaustion more pronounced, lips cyanotic, and the few dry râles later become numerous and moist.

The urine showed occasionally a trace of albumin and a few granular and hyaline tube casts. The sputum usually contained not only the influenza bacillus but also the pneumococcus, streptococcus, staphylococcus, and the micrococcus-catarrhalis. The leukocyte count usually showed a moderate leukopenia.

Severe Influenza was characterized by an exaggeration of the symptoms and signs of ordinary influenza, and complications were frequent.

The following incident illustrates the onset. Two well-developed and unusually strong coal-passers who were at work and in the best of health on a Thursday, when admitted to the U. S. Naval Hospital, League Island, the following morning were so weak that one fell on the floor and the other had scarcely sufficient strength to remain sitting on a chair.

The lips, lobes of the ears, and finger-nails showed cyanosis, varying in degrees from blueness to blue-black, and occasionally extended to the extremities, trunk, and the mucous membranes of the pharynx and larynx.

In many cases adynamia was so profound that normal breathing was impossible. When the patient was commanded to take a deep breath, he would make an obvious effort and breathe slightly more deeply, but each succeeding breath was weaker than its predecessor, evidencing weakness and rapid exhaustion. It is probable that feeble or absent breath sounds, when no pulmonary disease exists, excepting a moderate bronchitis, is in part due to the excessive weakness of the intercostal muscles and diaphragm due to deficient innervation and toxic myositis. Occasionally breath sounds were masked by numerous, loud, sibilant, sonorous and mucous râles.

Auscultation in bronchitis reveals an extremely weak respiratory murmur, and in many cases the breath sounds in one or

both of the lower lobes were absent. Vocal fremitus and resonance was diminished, and bronchitis râles were few and scattered.

Lobular pneumonia was very common and usually began in small areas disseminated throughout one or both lungs, frequently locating in the lower spinal half or the apex of one of the lower lobes and usually undiagnosable at first because of the feeble or absent breath sounds extreme engagement and emphysema. During ordinary respiration subcrepitant râles may be absent but may be induced by cough or deep inspiration. These râles are easily overlooked because of their small volume and low pitch or may be masked by loud dry râles. Even when small areas of lobular pneumonia become larger, the phonendoscope reveals scarcely audible, low-pitched, broncho-vesicular breathing, and percussion dulness may be absent if these areas are located in the central portion of the lung, or the surrounding tissue is emphysematous. When areas of lobular pneumonia coalesce and occupy the periphery, or a considerable part or the whole of a lobe of a lung, the percussion note is dull, the breath sound broncho-vesicular or bronchial, and vocal resonance and fremitus is increased. Respiration is superficial in all forms of this disease, but in severe influenza the respiratory murmur is not only feeble but remains feeble even though one or both lower lobes of the lungs become congested or pneumonic. The unaffected lung shows no compensatory over-action, so uniformly observed in lobar pneumonia. Passive venous congestion of the base of the lungs was common. Occasionally dulness on percussion and feeble breathing leading to the diagnosis of broncho-pneumonia would vanish over night, due to the disappearance of pulmonary congestion and collapse following the expulsion of a plug of tenacious muco-pus blocking one of the larger bronchial tubes. The cough was frequent, paroxysmal and often interfered with sleep. The sputum was at first mucoid and later muco-purulent, moderate in amount and frequently blood stained. The bloody sputum was usually at first bright red and later dark brown and occasionally salmon colored or rusty. When the sputum was

thin and watery resembling diluted red paint, the streptococcus hemolyticus was usually present and death usually ensued.

In mild and moderate influenza the respiratory rate was ordinarily normal. Whenever the respirations exceeded 24 per minute, pneumonia was suspected, and this suspicion was strengthened if the sputum was bloodstained, excepting when pleuritis caused the increased respiratory rate. Polymorphonuclear leukocytosis usually accompanies broncho pneumonia The combination of normal percussion resonance, vocal fremitus and resonance, with absence of breath sounds occurred so frequently that at first the author believed that his hearing was impaired, or that the stethoscope or phonendoscope was defective, but repeated observations corroborated the first observation and in describing this frequently recurrent group of signs the term "silent lungs" was employed. In the beginning it was difficult to ascertain the causes of these "silent lungs," but soon the following were recognized: (1) The lung failed to functionate because of adynamia and extreme weakness of the muscles of respiration; (2) extreme pulmonary engorgement; (3) obstruction of the lumen of the bronchial tubes by (*a*) inflammatory swelling of the mucosa, (*b*) tenacious and muco-purulent or hemorrhagic exudate; (4) collapse and congestion of an area of the lung, secondary to complete obstruction of the bronchus; (5) areas of lobular pneumonia surrounded by emphysema. Lobular pneumonia frequently exists unrecognized, or may later develop in condition described under 1, 2, 3 and 4.

Pleurisy almost always occurs as a complication of influenzal bronchopneumonia and may be serous, sero-fibrinous or purulent, frequently occurs in the absence of physical signs and symptoms and may be general, interlobar, or diaphragmatic.

The characteristic superficial friction rub was usually inaudible because of feeble respiration or because the exudate was butter-like in consistency. A crumpling or subcrepitant-like sound occurring at intervals during the early part of the inspiratory phase of respiration, simulating the crepitant râle of pneu-

monia or the subcrepitant râle of capillary bronchitis, at times replaces the characteristic friction rub. Pleural friction sounds may be masked by loud bronchitic râles. Frequently pleural friction crepitant and subcrepitant râles were simultaneonsly present. Large serous effusion seldom occurred. In a few cases the quantity of soft gelatinous exudate was so large that the physical signs simulated that of a serous effusion, but the aspirating needle revealed no fluid. In many cases the pleuritis remained plastic throughout but was usually accompanied by a serous exudate small in amount, light brown in color, high specific gravity, markedly albuminous and occasionally contained the pneumococcus or streptococcus. Serous exudate usually occurred without recognizable symptoms, but if not too small in amount were easily diagnosed by physical examination. In many cases of pleurisy the severe pain caused diminished pulmonary expansion, feeble breath sounds, an increased rate of respiration, and these same signs were occasionally observed in plastic pleurisy without pain, probably due to reflex action. Reflex pleuritic pains have been erroneously diagnosed as cholecystitis or appendicitis. Physical signs of a large serous effusion appeared over night in a few cases of bronchopneumonia without causing a marked increase in dysponœa, polypnœa or displacemant of the apex beat of the heart. This combination of signs and symptoms lead to the inference that although the physical signs indicated a large effusion, the absence of pressure signs was best explained by assuming that the effusion was moderate in amount and was located between layers of the pleura, having a thickness of about two inches, held in position by a non-collapsible bronchopneumonic lung. This clinical interpretation was confirmed later by a case that came to autopsy. In one case 200 c.c. of serous exudate were removed and a small pyro-pneumothorax developed as the bronchopneumonic lung could not expand. As a rule pleural exudates were absorbed, and when respiration was embarrassed, paracentesis was not performed. At short intervals a small quantity of the liquid was removed to determine whether

it remained serous or had become purulent. Extensive adhesions are common after pleurisy and frequently the x-ray reveals complete adhesion of the lung to the diaphragm. Usually interlobar and diaphragmatic plastic pleurisy were not diagnosable, but the latter may be suspected when friction sounds are heard over the borders of the lung or when referred pain occurs in the upper abdominal, gall bladder or appendix regions, or when the fleuroscope shows adhesions. Circumscribed, interlobar, or diaphragmatic pleural effusions are usually over-looked but should be diagnosed by the aspirating needle, physical signs and x-ray. Pyothorax was diagnosed with difficulty excepting when the amount of pus was large. Sacculated, interlobar and diaphragmatic empyema sometimes evaded diagnosis and was revealed by the sudden discharge through the lung of a pint or more of pus. After spontaneous rupture of an empyema into the lung the signs of pyo-pneumothorax often developed and recovery usually followed, but occasional drainage through the chest wall became necessary. Circumscribed interlobar empyema is more apt to evacuate through the lung than any other variety. In one case following a severe paroxysm of cough an emphysematous bleb over an area of bronchopneumonic lung ruptured into the pleural cavity, infected the pleura and caused a pyo-pneumothorax. In one case two sacculated empyemas were observed in one pleural sac.

During the epidemic of pneumonia occurring in the U. S. Naval Hospitals of Philadelphia in the winter of 1917 empyema occurred in 25 per cent. of the cases, consequently this complication was expected in this epidemic. Contrary to this expectation, however, empyema was of rare occurrence during the height of the epidemic and relatively few cases occurred later. When empyema appeared, the streptococcus or pneumococcus were usually present. Anti-streptococcus serum was of unquestioned value in a case of influenzal streptococcus empyema, and one case of influenza complicated by pneumonia followed by empyema, due to pneumococcus type I was greatly benefitted

by anti-pneumococcus serum, injected subcutaneously and also into the empyema cavity which had been partially evacuated by paracentesis.

In severe influenza circulatory disorders were almost as common as pulmonary disorders. Varying degrees of weakness of the heart muscles was usually present, and in most cases the muscular element of the first sound was remarkably weak and at times valve-like. Frequently the apex beat could not be seen nor felt. The cardiac neuromuscular mechanism was usually disturbed as shown by the frequency of the alteration in the pulse temperature ratio, as for example, temperature 104° F. pulse 80. As a rule the pulse was hypotensive and weak but regular in force and rhythm. Occasionally the cardiac rhythm was transitorily disturbed during a paroxysm of cough or by exertion. Arrhythmia from neuro-myocardial disease was rare, and in one case sudden and unexpected death occurred. The systolic and diastolic pressure was low, the pulse pressure large, and in a typical case the systolic pressure was 85 mm. and the diastolic 45 mm. The frequency of this blood pressure picture in association with the marked adynamia closely simulates that of advanced Addison's disease and suggests a diminution or loss of function of the adrenals. Although cardiac murmurs were usually absent, nevertheless it is possible that in certain cases, sufficient ventricular dilatation occurred to permit of tricuspid or mitral regurgitation, the absence of the murmur being due to myocardial weakness.

Pericarditis was conspicuous by its absence and hydropericardium was only occasionally observed. The superficial and deep veins were frequently over-distended, and the arteries seemed less full than normal, indicating a partial emptying of the arterial blood into the venous system.

Cyanosis was a frequent, striking and serious complication of the epidemic. In mild cases the lips, ears and finger-nails were slightly bluish; in ordinary cases the cyanosis of the lips and ears increased and also extended to the cheeks and hands; the color

became more distinctly blue. In severe toxic influenza cyanosis may extend all over the entire body and include the mucous membrane of the mouth, and the color may deepen to a bluish black. All the factors concerned with the cause of cyanosis could not be fully determined, but it was evident that the chief and perhaps the sole cause was a toxemia acting upon various organs and tissues of the body. There was evidently a disturbance of the function of the vaso motor mechanism and a diminution or loss of the function of the adrenals due to inflammation.

Toxic myocarditis caused pulmonary and venous congestion which was increased by the partial emptying of the arterial blood into the venous system, which with toxic bronchopneumonia favors suboxidation of the blood. Digitalis, atropine, and alcohol usually failed to produce their physiologic effect and venesection was useless or harmful.

In the nervous form of severe influenza, the mind was usually dull, somnolence was common, and the patient slept most of the time but was easily awakened. When toxemia is more marked, somnolency is replaced by slight, moderate or marked stupor or coma. Delirium may occur similar to that seen in typhoid fever, or may become maniacal and require physical restraint. In a few cases delirium continued for days accompanied by photophobia and slight retraction of the head simulating meningitis evidently due to a toxic irritation of the meninges and cerebral cortex as the spinal fluid showed no evidence of inflammation. Frequently lethargic or mildly stuporous patients with extensive bronchopneumonia, obviously critically ill and within twenty-four to forty-eight hours of death, nevertheless state that they feel well and request permission to leave bed and return to duty. This strange inability to appreciate the seriousness of their condition is probably due to a marked disturbance of the perceptive centers. Marked mental depression was not uncommon and was sometimes associated with the fixed idea that recovery was impossible and that death must follow.

Delusional insanity of the mild, melancholic or suicidal variety

occasionally occurred. A convalescent from influenza while working about the hospital wards, apparently improving, was suddenly seized with a suicidal impulse, secured a razor, cut his throat, but fortunately recovered; a second patient was foiled in an attempt to commit suicide by jumping from a height, and a third patient had a series of epileptiform convulsions preceded and followed by melancholic or depressive delusions from which he ultimately recovered. Adynamia is marked, and the decubitus indicates extreme muscular relaxation. Involuntary evacuation of the urine and feces is common, and the patient may unconsciously expectorate anywhere at any time.

In the gastro-intestinal form of influenza the most common symptoms are a coated tongue, foul breath, aversion to foods and drinks, unwillingness to swallow, anorexia, nausea and vomiting. The vomitus is usually free from blood, the abdomen may or may not be tympanitic and is not painful upon palpation. Blood appeared in the feces of three cases of influenza, one of which was complicated by typhoid fever.

Diarrhœa occasionally occurred when there was no evidence of gastro-enteritis nor ulceration, and it was evident that toxemia was the chief factor. This form of influenza was frequently fatal.

The renal form occurs in three fourths of the cases of severe influenza. The urine usually showed a trace or a moderate amount of albumin, a high specific gravity, granular and hyaline tube casts and not infrequently a number of erythrocytes, interpreted as indicating acute toxic nephritis. The volume of urine excreted was usually diminished, and clinically it was impossible to recognize evidences of uraemia which, if present were merged into the clinical picture of toxemia. In a few instances the phenolsulphonphthalein test for the functional activity of the kidneys was made, but the results were so contradictory that deductions were impossible. One would expect varying degrees of diminution of the renal function, and in severe toxemia the renal function should be almost abolished. Passive congestion of the kidneys was common.

Jaundice occurred infrequently and was due to toxic hepatitis, and no case of catarrhal hepatitis or cholecystitis was observed. Several cases of severe pain referred to the gall bladder region, due to pleurisy was diagnosed cholecystitis. In one case, a negro, the jaundice was so intense that the sputum was canary-yellow in color due to bile. About 50 per cent. of cases of jaundice terminated fatally. Primary sinusitis and otitis were rare, but occasionally latent sinusitis and otitis became acute during influenza. Paracentesis in acute otitis media usually yielded a bloody serum, but seldom pus. Epitaxis was very common and was usually associated with venous engorgement and passive swelling without evidence of inflammation. The blood seemed to ooze from the mucous membrane and usually no ulceration could be detected.

Hoarseness and aphonia occasionally occurred, and the laryngoscope showed passive congestion and swelling.

Commander W. A. Angwin (M.C.), U.S.N., has made the following statistical study of nine hundred cases admitted and discharged from the U. S. Naval Hospital between September 12 and November 15, 1918. Group 1 consists of 352 cases admitted within 24 hours of onset. Group 2 consists of 197 cases admitted within 48 hours of onset. Group 3 consists of 116 cases admitted within 72 hours of onset. Group 4 consists of 235 cases admitted after 72 hours of onset.

The symptoms in the order of frequency were headache, cough, general muscular pains, chills, backache, weakness, sore throat, coryza, nausea, dyspnœa, vertigo, vomiting, earache. The physical signs in the order of frequency in group were râles 51.9 per cent., congestion of the throat, eyes and nose, cyanosis, toxemia, enlargement of the superficial lymphatic glands, pleuritic friction, herpes and erythema. Râles, toxemia and delirium progressively and rapidly increased in frequency from group one to group four. Delirium occurred in 48.6 per cent. of all cases of pneumonia.

Groups.	Bronchitis.	Pneumonia.	Epitaxis.
1	43.0%	8.5%	5.6%
2	40.0%	15.7%	....
3	31.0%	42.2%	....
4	31.1%	42.8%	....

SPUTUM.

Groups.	Muco-purulent.	Bloody.	Watery.
1	52.2%	48.8%	0
2	52.6%	47.4%	0
3	41.0%	74.0%	8.7%
4	41.0%	56.4%	3.6%
Average.....	46.7%	56.6%	

Complications and Sequelae.—Toxemia dominates the clinical picture of influenza, and is not only the chief complication but also the chief cause of death. Young men possessed of unusual strength and vitality succumb without resistance due to the virulency of the toxemia.

The usual pulmonary, circulatory, nervous, gastro-intestinal and renal complications and cyanosis have all been sufficiently discussed. Hypostasis and pulmonary edema is a frequently fatal terminal complication of pneumonia. Uncommon complications are phlebitis, thrombosis, neuritis, paretitis, sinusitis, aphonia, herpes, purpura and subcutaneous emphysema. Relapses are not uncommon, but many so-called relapses occurring in convalescents are due to the recrudescence of existing bronchitis, pneumonia, or pleurisy or the conversion of a serous into a purulent pleural effusion. Any preëxisting disease, as for example, pulmonary tuberculosis or chronic Bright's disease, may become a serious or fatal complication or sequel by becoming active and progressive during an attack of influenza. Five cases of influenza were complicated by meningococcic cerebrospinal meningitis. One case of influenza developed diptheria and broncho-pneumonia involving the middle and lower lobe of the lung, and another typhoid fever and it is probable that all were carriers. Many carriers of the pneumococcus, streptococcus, staphylococcus became infected with the influenza bacillus.

Influenza occurring in carriers of various micro-organisms is the cause of many obvious or obscure complications.

The most common sequel of influenza is well-marked weakness, continuing many weeks, due to the effect of the toxemia upon the nervous system or myocardium causing well-marked symptoms of neurasthenia, circulatory, weakness, anginoid pain or angina pectoris, or the weakness may be circulatory and myocardial in origin.

Chronic bronchitis, chronic pleuritis, empyema (sacculated or general), pyopneumothorax, emphysema, chronic bronchopneumonia, chronic sinusitis, chronic otitis, may occur as complications or sequelæ.

A large number of influenza carriers may be expected as a sequel to this pandemic, as the sputum in 36 per cent. of the patients convalescent for two or three weeks still contained the influenza bacillus.

Pathology and Clinical Laboratory.—I am indebted to Lieutenant R. S. Leopold (M.C.), U.S.N.R.F., not only for the statistical tables, necropsy, pathological and clinical reports, but more especially for his enthusiastic coöperation during the epidemic.

The blood in influenza usually showed leukopenia and the white blood cells varied between 3,800 and 8,000 per cm. As soon as pneumonia occured a polymorphonuclear leukocytosis quickly developed, varying from 14,000 to 20,000 per cm. Leukocytosis usually antedated clinical diagnosis by two or three days. When leukocytosis diminishes during the active stage of influenzal bronchopneumonia the prognosis, was generally unfavorable.

The following table has been constructed by selecting from 600 blood counts, 100 from uncomplicated pneumonia and 100 from influenzal bronchopneumonia.

	W. B. C.	Polys.	S. L.	L. L.	Mono.	Trans.	Eos.
Influenza	6.950	67.5	21.2	3.8	4.4	2.1	0.3
Influenzal broncho-pneumonia	17.680	82.8	8.3	2.1	2.6	3.8	0.1

The following table is based upon 200 examinations of sputum selected from 600 cases of influenza between September 28 and October 28, 1918.

	Per Cent.
1. B. influenza (pure)	18
2. B. influenza and streptococci	14
3. B. influenza and pneumococci	12
4. B. influenza, streptoc. and pneumoc	12
5. Pneumococci	10
6. Streptococci	10
7. Pneumococci and streptococci	18
8. Total B. influenza present	62

In the sputum of patients convalescent two or three weeks the B. influenza were still present in appreciable numbers in 36 per cent. of the cases examined, thus demonstrating the probability of a high percentage of carriers.

The B. influenza was at first identified with difficulty and later with regularity and ease owing to improved technique. This organism was frequently associated with types 3 and 4 pneumococcus, occasionally with type 2 and only rarely with type 1. Streptococci of varying strain and virulency were associated with B. influenza, and occasionally the streptococci hemolyticus was identified and less frequently the microcatarrhalis and staphylococcus. In fifteen blood cultures twelve were negative, one showed a pneumococcus, and one a pneumococcus streptococcus. When the influenza bacillus and the streptococcus or pneumococcus were simultaneously cultured on the same plate, the colonies grew larger and more rapidly than if each organism were grown upon a separate plate, evidently due to symbiosis.

Spirillæ, not of the mouth variety, were frequently observed in the sputum, especially when bloody, from patients with influenza. The morphology of the organism was constant, it was relatively short, the ends curved, convolutions regular and about six or eight in number and stained faintly with strong fuchsin. These organisms were imbedded in muco-pus which had apparently come from the lower respiratory tract and were

observed in 14 cases of influenza and 9 cases of bronchopneumonia. 0.2 to 0.4 grams of salvarsan caused the disappearance of the spirillæ and apparently benefited the patient. Future research must determine the relation of this organism to influenza.

Dr. Leopold has made the important observation that from material obtained by an aspirating needle introduced into a broncho-pneumonic area, a pure culture of the bacilli was obtained, and that other organisms may be secured from areas surrounding the consolidation or from the contents of the bronchial tubes.

The relative frequency of the different types of pneumococci were as follows:

Type I	1.1
Type II	12.3
Type IIa	14.6
Type III	5.6
Type IV	25.6
Negative	40.6

In other parts of the United States the percentage of the different types varied.

A composite picture of nine autopsies would be about as follows: A robust, well-developed, muscular young male cadaver, presenting extreme cyanosis of the entire body, often of a deep purplish black and emitting a characteristic foul odor. The engorgement of the venous system was extreme and the subcutaneous and abdominal veins and cavæ were greatly over-distended, and the blood which flowed freely was black in color, watery in consistency, and produced a dark mahogany-colored stain. The right heart was enormously over-distended and filled with a blackish jelly-like clot.

The heart, pectoral, abdominal and recti muscles were all well-developed and often presented a glazed and scalded appearance.

The heart muscle fiber stained faintly, and the individual cell was swollen and faintly granular, the nucleus clouded and

the capsule indistinct. Between the bundles of the heart muscle fibers there was congestion, occasional minute hemorrhages, groups of infiltrated round cells and small collections of leukocytes.

The intimæ of certain of the cardiac arterioles showed marked proliferation sufficient to partially obstruct the lumen of the vessels.

An occasional serous pleural effusion and a few examples of seropurulent pleuritis were observed late in the epidemic.

The lungs presented constantly varying pictures of bronchopneumonia. The discreet areas of lobular pneumonia presented various stages of development, and some were well-defined, elevated, firm, varying in color from a reddish brown to bluish gray and surrounded by normal or collapsed lobules, giving a mosaic appearance. The areas of lobular pneumonia were often scattered throughout the middle and lower lobes and sometimes also appeared in the upper lobes often involving from 25 to 50 per cent. of the lungs. In other cases these areas rapidly coalesced, became massive, and simulated lobar pneumonia. These massive pneumonias often involved 75 per cent. of the lung and were of a bluish gray color and were occasionally associated with subpleural hemorrhages.

Bronchopneumonia invaded the lung in the following order of frequency—the right lower lobe, the left lower lobe, the middle lobe. In all types of pneumonia areas of extreme emphysema were observed, especially marked in the uninvolved lung. In one case pyo-pneumothorax developed secondary to the rupture of an emphysematous bleb over an area of broncho-pneumonia.

The trachea and bronchi contained a thin brownish tenacious exudate, and numerous minute petechial hemorrhages were common in and apparently under the mucosa.

Frequently the interlobular capillaries were intensely congested with areas of hemorrhagic extravasations. The alveoli were filled with red cells, leucocytes, fixed cells, debris but no fibrin. Peribronchial and perivascular round-celled infiltra-

tion was especially pronounced in the bronchopneumonic areas. Enlarged bronchial glands were often found about the roots of the lungs.

Only a few examples of sero-fibrinous or purulent pleuritis were observed.

The Influenza Committee of the Advisory Board of the D. S. M. S. France, reports in the *British Medical Journal* of November 9, 1918, that one of the most striking features of the morbid anatomy of the epidemic was the constant occurrence of dilatation of the heart with myocardial changes. Twenty-nine out of thirty cases showed marked dilatation of the heart chiefly of the right side, but very commonly of the left side as well, twenty-one cases showed myocarditis demonstrable to the naked eye. The myocardium was pallid and soft with mottling and frequently subpericardial and subendocardial hemorrhages similar to those seen beneath the pleura. These hemorrhages were also seen on the intra-ventricular septum and papillary muscles.

The pericardium usually showed no pathological change, and only occasionally was a moderate serous effusion observed. In a typical rapidly fatal case of toxic influenza, with bronchopneumonia and extreme cyanosis, the venous system was engorged with blood, the lumen of the divided ascending and descending venæ cavæ were distended to fully one-third larger than normal and filled with a currant jelly-like clot. When blood was removed from the pericardial sac, it quickly refilled with blood reguritation from the over-full venæ cavæ.

The gastro-intestinal tract showed no pronounced pathological change.

The spleen was usually somewhat enlarged, congested and of a deep purplish color. The liver was congested and sometimes showed marked biliary pigmentation.

The kidneys were congested, the cortex was usually deep brown in color and upon section showed a glazed and bulging surface. The microscope showed uniformly advanced inflam-

matory changes with extreme congestion, and the capillaries seemed almost ready to burst and hemorrhages were frequently observed. In and around the lobular and inter-lobular vessels there was advanced cloudy swelling, especially of the convoluted tubules, and in some cases inflammatory changes were taking place in the glomero-tubular portion of the kidney.

The adrenals were of a deep bronze color, enlarged, very friable, and extremely congested.

Major O. L. Pothier, M.C., U.S.A., Camp Lee, Va., in a report upon thirty-seven autopsies, states that during the first week of the epidemic the adrenals were intensely congested with beginning change in the epithelial tissue. After the second week the cellular element had disappeared leaving only a framework. He states that with the exception of the lungs no other internal organ suffered as much as did the adrenal.

If autopsies had been more numerous and research more exhaustive, doubtless evidence of toxic hepatitis, splenitis and pancreatitis would have been observed and possibly similar changes in other organs.

Diagnosis.—The diagnosis of influenza during an epidemic is based upon fever with a disproportionately slow pulse and respiration rate, pain in the head and extremities, flushed cheeks, bright eyes, injected conjunctivæ, and cough, quickly accompanied by muco-purulent expectoration. As a rule sneezing is absent, and when present, is apt to be due to an associated micrococcus-catarrhalis infection. The pulse and the muscular element of the first sound of the heart quickly become weak. The temperature is usually about 103° F. and the pulse only 100 per minute. Frequently bronchopneumonia exists with a respiratory rate of but 26 per minute.

A primary lobar pneumonia may be mistaken for a massive influenzal broncho-pneumonia.

The differential diagnosis is established by the character of the pulse and the first sound of the heart, the relative slow pulse and respirations, and the association of bronchitis or lobular

pneumonia in other lobes of the lungs. It is evident that in a few cases the pneumococcic infection was as great, if not greater, than the primary influenza infection, because of the rapid consolidation of one or more lobes of the lung and a typical crisis at the usual time. The diagnosis of other lung, pleural and circulatory diseases in severe toxic influenza have already been discussed.

Leukopenia is diagnostic of uncomplicated influenza, and polymorphonuclear leukocytosis appears when pneumonia occurs and may antidate the clinical diagnosis by two or three days. Materials for culture secured by introducing an aspirating needle into an area of broncho-pneumonia makes an etiological diagnosis possible.

Prognosis.—The estimated death rate at the U. S. Naval Hospital was 11.6 per cent. The actual mortality was lower as patients recovering while on leave were not included.

About one third of the cases of severe toxic influenzal bronchopneumonia and most of the cases of influenza with involvement of both lower lobes of the lung, succumb to the disease. When the sputum appears like diluted red ink, denoting infection by the streptococcus hemolyticus, death usually occurs. Well-marked stupor or persistent vomiting was unfavorable prognostically. Sudden death may occasionally occur in influenza when arrhythmia is present. In a few instances the usual clinical evidences of severe toxemia make the prognosis unfavorable even though bronchopneumonia be absent.

Occasionally acute tonsilitis was erroneously diagnosed influenza, but inspection of the fauces and a study of the pulse, temperature, respiration and leukocyte count makes the differentiation.

Practically all toxic psychoses improved and eventually recovered.

Acute parenchymatous nephritis usually disappeared but occasionally became chronic.

When a patient with influenza continues at work the prognosis

is unfavorable. Dr. J. J. Reilly, Chief Surgeon at Hog Island, states that two men with influenza, while at work, were accidentally killed and an autopsy showed bronchopneumonia.

Summary.

This epidemic was introduced into the United States by ships from abroad and differed markedly from preceding epidemics, and was characterized by rapid and severe onset, extreme contagiousness and high death rate.

The period of incubation was from one to four days.

The epidemic disappeared because most of the non-immunes had been infected.

Extreme susceptibility of the young adult and comparative insusceptibility of those past middle age.

Non resistance to the disease even by those of unusual strength and vigor.

Toxemia was the dominant cause of symptoms, complications and death, by direct action upon the tissues and organs of the body.

Cyanosis occurred frequently, and if extensive, was serious prognostically.

The chief and perhaps the sole underlying cause of cyanosis is toxemia. Some of the secondary causes of cyanosis are disturbance of the vasomotor system, toxic myocarditis, bronchopneumonia and congestion, over-full venous system, epinephritis, and suboxidation of the blood.

Hypoadrenalism was suggested because of the frequency of low systolic and diastolic and large pulse pressures with adynamia. In a series of thirty-seven autopsies many showed marked disease of the adrenals.

Importance of an exhaustive study of the adrenals in future epidemics of influenza.

Adynamia probably due to the effects of the toxemia upon the nervous and muscular systems and the adrenals.

Deficient pulmonary expansion is often due to toxemia affecting the muscles and nerves concerned with respiration.

The most common location of a beginning bronchopneumonia is in the apex of the spinal half of the lower lobe of the lung.

Bronchopneumonia may exist in the absence of breath sounds, due to non-entrance of air, and percussion resonance may be normal due to associated emphysema.

The appearance of the streptococcus hemolyticus in the sputum in influenza bronchopneumonia is usually followed by death.

Absence of compensatory over-action of the normal lung when massive bronchopneumonia exists is an indication of a disturbance of the neuro-muscular mechanism due to toxemia.

Pleural friction frequently closely simulates the crepitant and subcrepitant râles of bronchopneumonia.

Empyema was infrequent during this epidemic but was common during the epidemic of pneumonia in Philadelphia in the winter of 1917.

Referred pleuritic pain is often mistaken for cholecystitis or appendicitis.

Feeble or absent apex beat, weakened muscular element of the first sound, relatively slow pulse as compared with the fever are evidences of myocardial change or toxic myocarditis.

Frequency of toxic myocarditis at autopsy as observed by the influenza committee of the Advisory Board, D.S.M.S., France.

Meningismus was frequently mistaken for meningitis.

Prognosis usually favorable in post influenzal delirium and delusional insanity.

Prognosis unfavorable when vomiting is persistent.

About three fourths of the cases of severe toxic influenza developed catarrhal nephritis.

Leukopenia is diagnostic of uncomplicated influenza. Polymorphonuclear leukocytosis is diagnostic of bronchopneumonia and may antedate the clinical diagnosis by two or more days.

The prognosis is unfavorable when influenza occurs in a pneumococcic, streptococcic, staphylococcic, meningococcic, tubercular or typhoid carrier.

It was probable that this epidemic has created a large number of influenza carriers. The sputum of 36 per cent. of patients convalescent for two or three weeks contained the B. influenza.

B. influenza alone or combined with other organisms occurred in 62 per cent. of the sputa examined.

There was frequent occurrence of pure culture of B. influenza from the diagnostic puncture of the bronchopneumonic areas of the lung.

Type I pneumococcus was rare, but frequently occurred in other parts of the United States.

There was a symbiotic relationship of the B. influenza to the streptococcus or pneumococcus and perhaps other microorganisms.

Spirillæ were frequently observed in influenzal bronchopneumonia, especially when the sputum was bloody.

This epidemic of influenza seems to have been primarily due to the B. influenza, which may have been of the pandemic strain possessing unusual virulency. This influenza bacillus not only lessened remarkably the resistance but also greatly increased the susceptibility of patients with influenza to infection by other microorganisms. Many patients with influenza were quickly invaded by varying strains of the pneumococcus and streptococcus of high virulency. When an infection of two or more microorganisms occurred, it seemed as though each stimulated the other to more rapid growth and greater virulency. Perhaps the symbiotic relationship of the influenza bacillus to the pneumococcus or streptococcus seen in the laboratory may also occur in the human laboratory. Spirillæ so frequently observed in this epidemic might possess an importance now unrecognized.

Appendix A.

The epidemic of pneumonia in the winter of 1917 produced a large number of carriers, which may partly explain the frequency of pneumonia complicating influenza. The importance of carriers,

in explaining certain aspects of this epidemic is illustrated by the occurrence of influenza in five meningococcic carriers, each of whom quickly developed the symptoms of epidemic cerebrospinal meningitis. Some authors believe that an unknown microorganism or virus caused this epidemic.

DISCUSSION.

Dr. John D. Thomas: I am very much interested in Dr. Daland's experience in the Navy with the recent influenza epidemic. On the other side in the early stages of the epidemic we had some difficulty in diagnosing the pneumonic complications. And I would like to ask Dr. Deland if his diagnosis was by pathological or clinical means. In the early cases our diagnosis were nearly all clinical. Later we attempted bacteriological diagnoses as well. When we began x-raying our cases later we found that a goodly number showed evidence of pneumonic involvement, some in scattered and others in localized lobar forms.

Major J. N. Hall: There were fifty cases of influenza admitted with a diagnosis of acute appendicitis, of which only three were verified and operated. We had had during the previous year an incidence of appendicitis coming to operation of about 10 men per 1,000 per year. It reached in November and December, after the epidemic, an incidence of 44 per 1,000 per year. We had 92 men operated for appendicitis, and in many instances perforation had occurred even before admission. There were no constant bacteriological findings.

The reader will be interested to know that many cases of acute hemorrhagic adrenalitis occurred in the camps and in many more instances the post mortem examination showed small interstitial hemorrhages into the gland. Thus there is an anatomical basis for the symptoms suggesting Addison's disease. Low blood pressure was a feature of many cases of pneumonia following influenza, persisting even for months.

Commander Judson Daland: During the epidemic of influenza, we had several cases of appenditicis and a few cases of cholecystitis. During the epidemic there were quite a number of cases of referred pain in the appendix or gall bladder regions erroneously diagnosed appendicitis or cholecystitis.

RADIOGRAPHIC CHANGES SEEN IN INFLUENZA PNEUMONIA.

By Lt.-Col. ESTES NICHOLS, M.C., U.S.A.,

PORTLAND, MAINE.

The opportunity to study influenza from a radiological point of view was very unusual in the Army and especially at U. S. Army General Hospital No. 16, where this study was undertaken in a modern hospital, thoroughly equipped and the x-ray department in charge of a most capable and brilliant officer, Major James A. Honeij. The radiographic examination of the very sick patients was possible because of the bedside x-ray apparatus which enabled us to do a routine x-ray examination on very sick patients with very little disturbance to them. The very earliest cases were radiographed in an upright position and later in bed in the prone and upright posture. In the influenza cases it was the common occurrence to have a remission about the third day. This was followed with bronchial cough for about a week, when apparently the patient's condition became normal. In cases with pulmonary complications it was after the second remission that bronchopneumonia developed.

It is important to understand what appearances should be looked for in the study of the radiographs of influenza and pneumonia. In the radiographs of the influenzas there was a general increase of density throughout the lungs; this density being best described as of a hazy or smoky nature. This generalized density usually extended from apex to base, the inner half, especially adjacent to the mediastinal border, being most marked. The most marked changes are seen in the bronchial structures themselves. Peribronchial thickening was seen most marked around the hilus, extending outward in a "sunburst" type and

rapidly diminishing in size from the hilus to about the outer one third of the lung. This was more marked on the right than on the left, partly because the left is obscured by the heart.

A large number of cases of marked bronchitis or bronchopneumonia occurred at the right base. In cases where influenza

FIG. 1. Bronchopneumonia at Base, Diffuse Type.

progressed toward recovery there is a general diminution first in the hazy density and then in the diffuse density of the bronchial structure. The density around the hilus is due partly to peribronchial thickening and remains considerably longer. The hilus becomes affected very early and in no case is there any question of this reaction of the hilus. The heart shows a dilatation of the right auricle and a slight dilatation of the pulmonic area, but the heart as a whole is not much enlarged in influenza. Unilateral congestion was seen in a few cases, which invariably recovered in a few days.

They all show that the lower bronchial structure and the

bronchi of large diameters are earlier and more markedly affected than the smaller and terminal branches. There was evidence of diminished pulmonary function as evidenced by the height and shape of the diaphragm, as the diaphragm becomes much more dome-shaped than common. This was true in most cases.

FIG. 2. Typical Lobar Pneumonia, Right Upper Lobe, to Show the Difference Between Lobar and Bronchopneumonia.

Appearances to be Looked for in the Radiographs of Broncho-Pneumonia.—The first change seen after those described under influenza are of apparent bronchial nature. There seems to be diffuse peribronchial thickening so that the individual outlines of the bronchi can be made out with difficulty. This is shown as extending through the hilus outward and downward in most cases and there may be localized areas in which the bronchial outline resembles somewhat the "pussy willow" stage, like the budding of the willow branch seen in the spring.

The next distinct stage is a spreading out of these areas to

a point of confluent or more or less localized areas. In these areas the congestion appears light and hazy in many instances having a "powder-puff" appearance which often has a soft, diffuse outline. There were a few cases where resolution began in this stage, but in the majority of cases the process progresses and the density increases and the detailed structure becomes obscured. This causes the pulmonary changes to become more extensive and definite and the bronchial outlines are no longer apparent. In short, a pseudo-lobar pneumonia appearance may be seen. Frequently it occurs that after one portion of the lung has consolidated in one lung, the next earliest change is seen on the opposite side, extending outward from the hilus after the primary hilus changes. Consolidation occurs most often in the right lower lobe just medial to the inferior angle of the scapula. The next affected is the left lower lobe, then the right upper and middle lobes, and finally the left upper lobe.

Associated with the early bronchial changes are the marked changes of the hilus on the side where these bronchial pulmonary changes begin. In the marked changes of bilateral pneumonia where the greater part of both lungs is affected, the bases become so dense that a differential diagnosis between an extensive edema, pleural effusion and pneumonia cannot be made.

Two associated changes occur very early in the onset of pneumonia. First, invariably as early as the changes occur in the hilus there is seen marked acute dilatation of the right auricle and also marked dilatation of the pulmonic areas. In a considerable number of cases dilatation of the aorta also occurs. In a few cases dilatation of the left ventricle was seen. The second associated change has to do with the position and shape of the diaphragm. In the majority of cases the diaphragm on the side first affected becomes more dome-shaped and its position one or two interspaces higher than normal. This was so marked and occurred so constantly that it was emphasized as one of the diagnostic features of the disease. In massive types of pneumonia the diaphragm was often lower than usual.

The changes, therefore, described first show bronchial congestion associated with hilus changes, then localized congestions

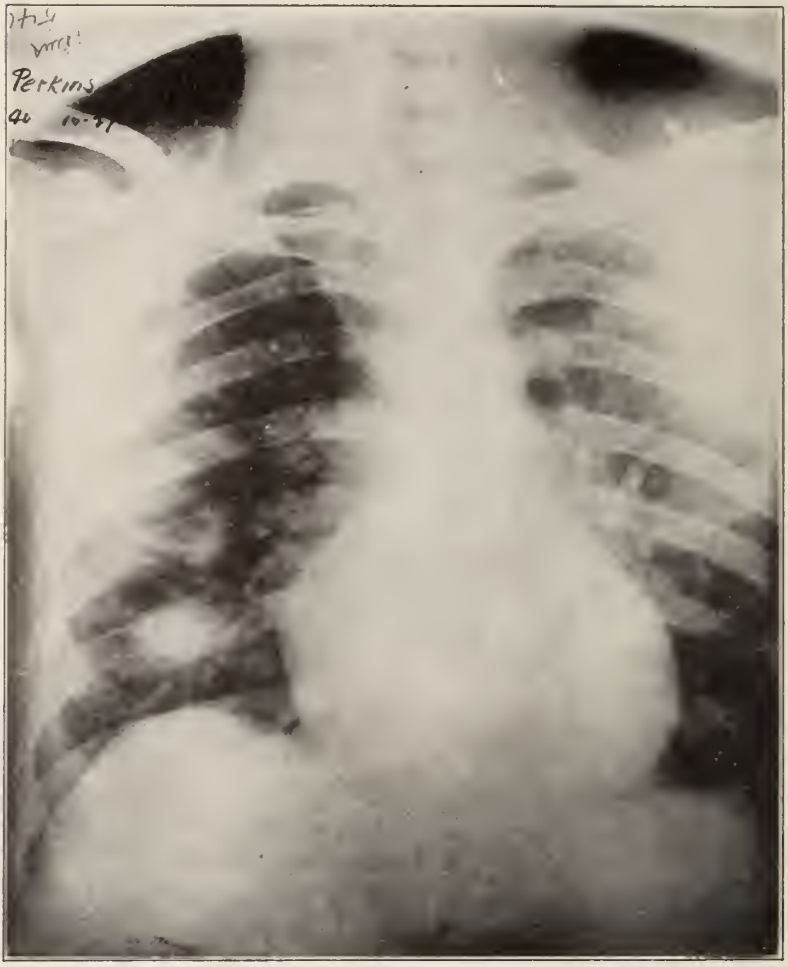

FIG. 3. Typical Bronchopneumonia with Dome-shaped Diaphragm, Dilatation of Right Auricle and Aorta. Powder-puff Appearance.

of the bronchioles and lastly a congestion of the true parenchyma. The early dilatation of the heart accentuates the acute conges-

tion of the lungs and the marked changes of the diaphragm indicate the early impairment of the respiratory function on the side affected. In a few difficult cases there was some trouble in differentiating the true bronchopneumonia from the lobar type and it was only possible to make this diagnosis after resolution began. As you all well know, resolution of lobar pneumonia begins near the hilus and retrogresses toward the periphery, whereas in bronchopneumonia this is reversed and resolution begins at the periphery.

Leucopenia is found with bronchopneumonia and leucocytosis is generally found with lobar pneumonia.

In a few cases a pleural reaction was demonstrated, shown by the congestion and thickening of the pleura in the inter-lobar fissure. From the observation of cases which recovered the attention of the staff was called to the slow improvement and the gradual changes in the lungs and the persistency of the congestion of the hilus and mediastinum. This was not only demonstrated by the radiograph but also by d'Espine's sign, which seems to be of some prognostic value and was found to be present in more than 50 per cent. of all cases at examination. The appearance of tuberculosis with influenza and bronchopneumonia is extremely difficult to make out unless the tuberculous lesions are ancient ones and not of recent activity.

DISCUSSION.

Major J. N. Hall: I examined a great number of gassed case by order of the Surgeon General's office and paid special attention as to presence of tuberculosis. I never saw a case where tuberculosis was proved in these cases. A great number of cases developed asthma. In the California camps, certain men had asthma all the time, but stated that when they came over the high plateau country their asthma had somewhat cleared up.

EARLY RECORDS OF INFLUENZA EPIDEMICS IN AMERICA.

By Dr. GUY HINSDALE,

HOT SPRINGS, VA.

The earliest record of influenza in America was made by Hubbard whose "Manuscript"* under date of 1647 informs us that: "In 1647 an epidemic sickness passed through the whole Country affecting the colonists and the natives, English, French and Dutch. It began with a cold and in many accompanied with a light fever. * * * It extended through the plantations in America and in the West Indies. There died in Barbadoes and St. Kitts, 5000 or 6000 each." †

Noah Webster, the famous lexicographer, in his "Brief History of Epidemic and Pestilential Diseases," published in Hartford, Conn., in 1799, in two volumes, gives in chronological order a list of epidemics of "influenza or epidemic catarrh" dating in Europe from A.D. 1174, and in America from 1647.

In this remarkable list of 44 instances of influenza there are most interesting notes of earthquakes, volcanic eruptions and comets, since it was the fashion in those days to associate something supernatural with the outbreak of a pestilence.

So we read that the epidemic of 1174 was "the year before an eruption of Etna"; that of 1510 "the *same* year with an eruption in Iceland and following great earthquakes. Humid air—a comet appeared the next year"; in 1647, "First catarrh mentioned in American annals. The same year with violent earthquakes in South America. A comet."

In Noah Webster's view, Etna, Vesuvius, comets and earth-

* See pages 276 and 285.

† See pages 104–105, this volume.

quakes loom large in etiology. He states* in regard to the epidemics listed:

1. That most of them happened, after or during severe cold, or during moist weather and in spring, winter or autumn. Some however, occurred in dry, hot seasons, and others in mild winters.

2. Nineteen instances occurred in years when there was a volcanic eruption in Italy or Iceland, and eleven others, though in different years, were within a few months of eruptions; making 30 out of the 44. Two or three others happened near the time of volcanic discharges in South America.

3. Almost all happened in years of earthquakes, or within a few months preceding or following them.

4. Thirty instances occurred within the year, or a few months preceding or following the appearance of comets.

It is further to be observed that some of these epidemics have been limited to the American hemisphere, at the distance of three, four or five years from an epidemic of the same kind in Europe. Such as those of 1647–1655—which coincide in time with violent earthquakes in South America.

It is very remarkable and, I think, worthy of record that the epidemic of influenza which ravaged the Atlantic seaboard shortly after the Revolution had practically all the features of the recent epidemic. There was no better clinician in those days than Dr. Benjamin Rush, who held the chair of the practice of medicine and of clinical practice in the University of Pennsylvania.

Rush had the unusual faculty and patience to set down the minute details of cases as they came under observation. He was deeply interested in the weather as it affected the sick and the well and he urged his students to make a study of meteorology; this was partly because of the evident relation of epidemic diseases to state of the atmosphere. Climatic influences always had for him a prominent place in etiology. Incidentally it is interesting to note that he positively denied that yellow fever is contagious and after a hundred years this was admitted.

* Vol. II, pp. 33–36.

On turning to Rush's lecture on influenza as published in his "Inquiries and Observations," one is struck with a very remarkable parallel between the course of the epidemic of 1789 and 1790 and that of 1918 and 1919.

In the account preserved to us by Benjamin Rush there are many of the familiar symptoms so noticeable in the last epidemic. Rush in his usual manner noticed that the epidemic followed a cool summer and in the early cases it occurred in those suffering from fatigue. Then follows a classic description of the extraordinary sneezing, with hoarseness and sore throat; a sense of weariness, chills and fever. There were pains in the head, abscesses in the frontal sinus and watery eyes and a swelling just behind the ears, now recognized as the familiar mastoiditis. Then there was the distressing cough which in some cases was more of a tracheitis and the final pneumonia. Rush recognized and described the abdominal form; also the fact that those employed in out of door occupations, such as longshoremen, surveyors and the Niagara Indians, had it severely. He notes the occurrence of insanity consequent upon influenza. Rush probably also observed the effects of the streptococcus hemolyticus, for he described "Streams of blood" and spitting of blood in consequence of the violence of the cough.

Dr. Rush's account is of great historic interest and it reveals such a parallel between the clinical course of these epidemics separated by 129 years that I append his account in his own words.

An Account of the Influenza as it Appeared in Philadelphia in the Autumn of 1789, in the Spring of 1790 and in the Winter of 1791, from "Medical Inquiries and Observations" by Benjamin Rush, M.D. Published in Philadelphia 1819.

The latter end of the month of August, in the summer of 1789, was so very cool that fires became agreeable. The month of September was cool, dry, and pleasant. During the whole of this month, and for some days before it began, and after it ended, there had been no rain. In the beginning of October, a number of the members of

the first congress, that had assembled in New York, under the present national government, arrived in Philadelphia, much indisposed with colds. They ascribed them to the fatigue and night air to which they had been exposed in travelling in the public stages; but from the number of persons who were affected, from the uniformity of their complaints, and from the rapidity with which it spread through our city, it soon became evident that it was the disease so well known of late years by the name of the influenza.

The symptoms which ushered in the disease were generally a hoarseness, a sore throat, a sense of weariness, chills, and a fever. After the disease was formed, it affected more or less the following parts of the body. Many complained of acute pains in the head. These pains were frequently fixed between the eyeballs, and in three cases which came under my notice, they were terminated by abscesses in the frontal sinus, which discharged themselves through the nose. The pain in one of these cases, before the rupture of the abscess, was so exquisite that my patient informed me that he felt as if he should lose his reason. Many complained of a great itching in the eyelids. In some the eyelids were swelled. In others, a copious effusion of water took place from the eyes; and in a few, there was a true ophthalmia. Many complained of great pains in one ear, and some of pains in both ears. In some, these pains terminated in abscesses, which discharged for some days a bloody or purulent matter. In others, there was a swelling behind each ear, without a suppuration. . . . Sneezing was a universal symptom. In some, it occurred not less than fifty times a day. The matter discharged from the nose was so acrid as to inflame the nostrils and the upper lip, in such a manner as to bring on swellings, sores, and scabs in many people. In some, the nose discharged drops, and in a few streams of blood, to the amount in one case, of twenty ounces. In many cases it was so much obstructed as to render breathing through it difficult. In some, there was a total defect of taste. In others, there was a bad taste in the mouth, which frequently continued through the whole course of the disease. In some, there was a want of appetite. In others, it was perfectly natural. Some complained of a soreness in their mouths, as if they had been inflamed by holding pepper in them. Some had swelled-jaws, and many complained of toothache. I saw only one case in which the disease produced a coma.

Many were affected with pains in the breast and sides. A difficulty of breathing attended in some, and a cough was universal. Sometimes this cough alternated with a pain in the head. Sometimes it preceded this pain, and sometimes followed it. It was at all time distressing. In some instances it resembled the chin cough. One person expired in a fit of coughing, and many persons spat blood in consequence of its violence. I saw several patients in whom the disease affected the trachea chiefly, producing great difficulty of

breathing, and, in one case, a suppression of the voice, and I heard of another in which the disease, by the falling on the trachea, produced a cyanche trachealis. In most of the cases which terminated fatally, the patients died of pneumonia notha.

The stomach was sometimes affected by nausea and vomiting; but this was far from being a universal symptom.

I have met with four cases in which the whole force of the disease fell upon the bowels, and went off in a diarrhoea; but in general the bowels were regular or costive.

The limbs were affected with such acute pains as to be mistaken for the rheumatism, or for the breakbone fever of 1780. The pains were most acute in the back and thighs. Profuse sweats appeared in many over the whole body in the beginning, but without affording any relief.

It affected adults of both sexes alike. A few old people escaped it. It passed by children under eight years old with a few exceptions. Out of five and thirty maniacs in the Pennsylvania Hospital, but three were affected with it. No profession or occupation escaped it. The smell of tar and tobacco did not preserve the persons who worked in them from the disease, nor did the use of tobacco, in snuff, smoking or chewing, afford a security against it.

Even previous and existing diseases did not protect patients from it. It insinuated into sick chambers, and blended itself with every species of chronic complaint.

It was remarkable that persons who worked in the open air, such as sailors, and longshoremen (to use a mercantile epithet) had it much worse than tradesmen who worked within doors. A body of surveyors, in the eastern woods of Pennsylvania, suffered extremely from it. Even the vigor of constitution which is imparted by the savage life did not mitigate its violence. Mr. Andrew Ellicott, the geographer of the United States, informed me that he was a witness of its affecting the Indians in the neighborhood of Niagara with peculiar force. The cough which attended the disease was so new and so irritating a complaint among them that they ascribed it to witchcraft.

It proved most fatal on the seashore of the United States.

Many people who had recovered, were affected a second time with all the symptoms of the disease. I met with a woman, who after recovering from it in Philadelphia, took it a second time in New York and a third time upon her return to Philadelphia.

Many thousand people had the disease, who were not confined to their houses, but transacted business as usual out of doors. A perpetual coughing was heard in every street of the city. Buying and selling were rendered tedious by the coughing of the farmer and the citizen who met in the market places. It even rendered divine service scarcely intelligible in the churches.

A few persons who were exposed to the disease escaped it, and

some had it so lightly as scarcely to be sensible of it. Of the persons who were confined to their houses not a fourth part of them kept in their beds.

It proved fatal (with few exceptions) only to old people, and to persons who had been previously debilitated by consumptive habits. It likewise carried off several hard drinkers. It terminated in asthma in three persons whose cases came under my notice, and in pulmonary consumption, in many more. I met with an instance of a lady, who was much relieved of a chronic complaint of her liver; and I heard of another instance of a clergyman whose general health was much improved by a severe attack of this disease.

It was not wholly confined to the human species. It affected two cats, two house dogs and one horse within the sphere of my observations.

In the treatment of the influenza I was governed by the state of the system. Where inflammatory diathesis discovered itself by a full or tense pulse, or where great difficulty of breathing occurred, and the pulse was low and weak in the beginning of the disease, I ordered moderate bleeding. In a few cases in which the symptoms of pneumony attended, I bled a second time with advantage. In all these instances of inflammatory affection, I gave the usual antiphlogistic medicines. I found that vomitus did not terminate the disease, as they often do a common catarrh, in the course of the day or a few hours.

The duration of this epidemic in our city was about six weeks. It spread from New York and Philadelphia in all directions, and in the course of a few months, pervaded every state in the union. It was carried from the United States to several of the West India Islands. It prevailed in the island of Grenada in the month of November, 1789 and it was heard of in the course of the ensuing winter in the Spanish settlements in South America.

The following winter was unusually mild, insomuch that the navigation of the Delaware was not interrupted during the whole season, only from the seventh to the twenty-fourth of February. The weather on the third and fourth of March was very cold, and on the eighth and ninth days of the same month, the mercury stood in Fahrenheit's thermometer at four degrees at seven o'clock in the morning. On the tenth and eleventh, there fell a deep snow. The weather during the remaining part of the month was cold, rainy and variable. It continued to be variable during the month of April. About the middle of the month there fell an unusual quantity of rain. The showers which fell on the night of the seventeenth will long be connected in the memories of the citizens of Philadelphia, with the time of the death of the celebrated Dr. Franklin. In the last week of the month the influenza made its appearance. It was brought to the city from New England and affected, in its course, all the inter-

mediate states. Its symptoms were nearly the same as they were in the preceding autumn, but in many people it put on some new appearances. Several persons who were affected by it had symptoms of madness, one of whom destroyed himself by jumping out of the window. Some had no cough, but very acute pains in the back and head. It was remarked that those who had the disease chiefly in the breast the last year, complained now chiefly of their heads, while those whose heads were affected formerly, now complained chiefly of their breasts. In many it put on the type of an intermitting fever. Several complained of constant chills, or constant sweats; and some were much alarmed by an uncommon blue and dark color in their hands. I saw one case of ischuria, another of an acute pain in the rectum, a third of anasarca, and a fourth of a palsy in the tongue and arms; all of which appeared to be anomalous symptoms of the influenza. Sneezing, and pains in the ears and frontal sinus, were less common now than they were in the fall; but a pain in the eyeballs was a universal symptom. Some had a pain in the one eye only, and a few had sore eyes, and swellings in the face. In two persons whom I saw, the cough was incessant for three days, nor could it be composed by any other remedy than plentiful bleeding. A patient of Dr. Samuel Duffield informed me, after his recovery, that he had had no other symptom of the disease than an efflorescence on his skin, and a large swelling in his groin, which terminated in a tedious abscess.

The prisoners in the jail who had it in the autumn, escaped it this spring.

During the prevalence of this disease, I saw no sign of any other epidemic.

It declined sensibly about the first week in June, and after the twelfth day of this month I was not called to a single patient.

The remedies for it were the same as were used in the fall.

I used bleeding in several cases on the second, third and fourth days of the disease, where it had appeared to be improper in its first stage. The cases which required bleeding were far from being general. I saw two instances of syncope of an alarming nature, after the loss of ten ounces of blood; and I heard of one instance of a boy who died in half an hour after this evacuation.

I remarked that purges of all kinds worked more violently than usual in this disease.

The convalescence from it was very slow, and a general languor appeared to pervade the citizens for several weeks after it left the city.

I shall conclude this account of the influenza by the following observations:

1. It exists independently of the sensible qualities of the air, and in all kinds of weather. Dr. Patrick Russel has proved the plague to be equally independent of the influence of the sensible qualities of the atmosphere, to a certain degree.

2. The influenza passes with the greatest rapidity through a country, and affects the greatest number of people, in a given time, of any disease in the world.

3. It appears from the histories of it which are upon record, that neither climate, nor the different states of society, have produced, any material change in the disease. This will appear from comparing the account I have given, with the histories of it which have lately been given by Dr. Grey, Dr. Hamilton, Dr. A. Fothergill, Mr. Chisholm, and other modern physicians. It appears further, that even time itself has not been able materially to change the type of the disease. This is evident, from comparing modern accounts of it with those which have been handed down to us by ancient physicians.

I have hinted in a former essay at the diminutives of certain cases. There is a state of influenza, which is less violent and more local, than that which has been described. It generally prevails in the winter season. It seems to originate from a morbid matter, generated in crowded and heated churches, and other assemblies of the people. I have seen a cold, or influenza, frequently universal in Philadelphia, which I have distinctly traced to this source. It would seem as if the same species of diseases resembled pictures, and that while some of them partook of the deep and vivid nature of mosaic work, others appeared like the feeble and transient impression of water colors.

A third epidemic of influenza occurred twenty-seven years after the one described by Rush. We have a brief record by the indefatigable Daniel Drake in his "Systematic Treatise on the Principal Diseases of the Interior Valley of North America." This work in two volumes of nearly a thousand pages each was published after his death and is a monumental record of the history of clinical medicine as he and his colleagues observed it during the first half of the last century.

It will be noticed that Drake was acting as an army surgeon to two regiments of militia in camp where the influenza swept down from the east to the frontier post in the Ohio Valley where he was stationed. Drake describes it in these words:

1. *History.*—The cause of this malady is as utterly unknown, as the place where any one of its invasions commenced. I am unable to say how often it has traversed our interior valley, for its vast uniformity of surface leads to an extensive production of the endemic disease at the same time, when it is generally

called influenza, and the means of distinguishing it from that malady do not exist. It is sufficient to know that we have been invaded by this exotic epidemic.

The first and greatest invasion of this kind which I have had an opportunity of witnessing, occurred in the year 1807. In the summer or early autumn, the newspapers brought the intelligence of its prevalence in Europe and afterwards that it had reached our eastern cities. It was in October, when the weather was fine and steady that it appeared in this locality. Two regiments of militia called into the field to repel from our frontier a threatened invasion of Indians, were at the time encamped a few miles out of town and I was then in attendance upon them. These men were its first subjects, the people of the town still being healthy. In a few days, however, it reached the latter, and then sought out the scattered inhabitants of the country. At that time there was but little communication between our settlements, yet I was able to ascertain that it "spread far and wide" among them.

I need not give the history of any other prevalence, as this illustrates the most constant of the laws which govern influenza; first its progressive extension from east to west; second its independence of all sensible conditions of the atmosphere; third, its first outbreak in bodies of men, and compact settlements.

2. *Symptoms.*—While the symptoms of this new visitant were substantially the same as those of catarrh, there were modifications which deserve notice. Thus, although it often commenced in the nares alone, it seemed at the same time to invade the whole respiratory membrane. There was more fever, and the signs of inflammatory orgasm were often very apparent; but the highest characteristic, not always present, was a sense of sinking and prostration, with a serious feeling of disorder throughout the whole system, indicating the impress of some malignant agent. In subsequent epidemics, I met with cases of the same kind; although they did not prove fatal, they suggested the idea of danger.

Dr. Drake closes his account by noting among the sequels of influenza the occurrence of purulent pleural effusions and the unusual member of cases of pulmonary phthisis that developed.

Dr. David Ramsay and Dr. Joseph Johnson, two eminent physicians of South Carolina, made interesting records of this epidemic, extracts from which I have received through the kindness of our member Dr. Robert Wilson, of Charleston.*

Under date of 1808 Dr. Ramsay says: "Many persons remember that the influenza, after traversing the United States in 1789, reached Carolina and spread extensively. * * *

"More have reason to remember the influenza of 1807. This disease originated in New York in the month of August, and spread from that centre in all directions. It reached Canada in October, and had extended to the western and southwestern States, and even to the Havana in the course of three months. Members of Congress on their way to Washington, where they were summoned to assemble on the 26th day of October, while travelling from their respective homes, met the disease in every State. Its progress was so rapid as to outstrip the slow movements of contagion, and must have risen from some morbid constitution of the air. This is more probable from the circumstance that it was caught at sea by persons approaching the coast of America from distant countries.

"Gradually advancing from the northern States, it reached Charlestown early in September. It spared neither age nor sex, though children oftenest escaped altogether; or if attacked, got through the disease with the least inconvenience. The reverse was the case with aged persons. It soon became so general that in some large families there was not a sufficiency of persons in health to attend on the sick. In a few weeks it is supposed that 14,000 persons, or half the population of Charles-

* David Ramsay, "History of South Carolina," 1858, Vol. II, pp. 50–51.

Joseph Johnson, annual address, Medical Society of South Carolina, December 24, 1807.

See Charleston *Courier*, October 15 and 23, 1807, and December 23, 1808. *News and Courier*, February 3, 1919.

town, had been afflicted with that disease. Of these, forty-five died; thirteen of whom were white persons and thirty-two negroes. The former were generally aged persons. The disease spread on all sides into the country. The mortality in Georgetown and Beaufort was considerably greater than in Charlestown. The disease in many cases was so mild as to preclude the necessity of application to a physician. In dangerous cases, when medical aid was required, bleeding, blistering, emetics, cathartics and sudorifices were chiefly relied on.

"The influenza in its commencement resembled the yellow fever with a pain in and over the eyes, and with red streaks over their whites. A sharp acrid serum was discharged from the eyes, and sometimes from the nostrils. In such cases a hoarseness and soreness of the throat was usual. The sense of smelling was sometimes impaired, the hearing was frequently injured and in a few cases the powers of vision were diminished. A tightness and stricture across the breast, with a dry cough, was common. The matter expectorated was occasionally tinged with blood. The whole mucous membrane lining the fauces, nostrils, and bronchia, was uncommonly stuffed with phlegm. In the aged the disease assumed the form of a peripneumony; in the young and plethoric, that of a pleurisy. Persons of a consumptive diathesis, or who had been subject to old coughs or diseases of the breast, suffered most and oftenest relapsed. Spittings of blood and other serious precursors of consumption attacked such patients after the disease had in their cases vanished and generally disappeared. An uncommon increase of consumptions followed in the year 1808, which exceeded anything ever before known in Charleston."

Dr. Johnson began his address with an account of the weather, commenting in detail on the severity of the cold with which the years had set in:

"After a cold and backward spring there followed an abnormally hot and dry summer, and this was succeeded by a long drought in the fall. The 'endemial fever' raged and September was, 'from sickness and death, the blackest month ever

recorded in Charleston, there having been 328 interments, of which 114 were from endemial causes, and at least one-fourth of the inhabitants (estimated at 28,000 in number) were affected with influenza about the last of the month.'

"During October and November 'the inhabitants were distressed still more by the clouds of dust which drifted in every direction. . . . All the ponds and many of the wells and springs were dry, so that in country places many cattle died for want of water and travelers could not obtain a sufficiency near the roads either for themselves or their horses.'

"At this time a comet, which was first observed on September 15, though Dr. Johnson thinks it was probably visible for some time before that date, was arousing much discussion. 'By many,' says Dr. Johnson, 'the dreadful influenza that oppressed them, with all the aggravations of the drought, were ascribed to this comet.' The doctor ridicules such a superstitious theory.

"So general was the prevalence of this disease about the middle of October that many families had from fifteen to twenty sick at one time; servants could not be hired to do the duties of a family, nor nurses procured to attend the sick. Relapses were frequent. In all such cases the symptoms were greatly aggravated and frequently accompanied by violent determinations to the Pleura and Mediastinum."

The magnitude of the recent epidemic of influenza in 1918–19 has not been fully measured, but it seems to have exceeded any previous one of which we have any record. The London *Times* has stated that the deaths in the entire world have numbered six millions. We have no definite means of corroborating this estimate but it is estimated by the Bureau of the Census that in the United States the deaths in this epidemic, including influenza and pneumonia, have reached 700,000.

In Canada in 1918 there were 13,880 deaths in a total of 53,700 cases of influenza. In India alone over 4,000,000 have died in this epidemic.

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A. D. 1647. This year appeared an epidemic catarrh in *America*, and the firſt of which we have any account. It is not named either influenza or catarrh, but is clearly the ſame diſeaſe. It is thus deſcribed in Hubbard's Manuſcript, p. 276. "In 1647 an epidemic ſickneſs paſſed through the whole country, affecting the coloniſts and the natives, Engliſh, French and Dutch. It began with a cold and in many accompanied with a light fever. Such as bled or uſed cooling drinks died—ſuch as made uſe of cordials and more ſtrengthening things, recovered for the moſt part. It extended through the plantations in America, and in the Weſt-Indies. There died in Barbadoes and St. Kitts, 5 or 6000 each. Whether it was a plague, or peſtilential fever, in the iſlands, accompanied by great drouth, which cut ſhort potatoes and fruits."

This epidemic was in the ſame year with the earthquake in Chili, but the date of the diſeaſe is not recorded.

In Connecticut prevailed a malignant fever, occaſioned by the exceſſive heat of the ſummer.†

The year 1648 appears to have been leſs ſickly, in London; but in the ſouth of Europe, malignant diſeaſes were the harbingers of the plague, which in 1649 carried off 200,000 people in the ſouthern provinces of Spain. In Ireland and Shropſhire the plague prevailed in the ſame year, and a fatal fever in France. The ſmall pox was epidemic in Boſton.

Townſend's Travels, vol. 2. 219. Short, vol. 1. Douglas' Summary, vol. 2. 395.

In 1650 was an eruption of Etna, and an earthquake in the north and weſt of England. In this and the following year the plague continued in Ireland.

In 1650 the influenza ſpread over Europe. In 1651 many deſolating floods happened in Holland and France—in Italy, a quinſy or ſore throat proved very fatal to children. Theſe diſeaſes were ſucceded by malignant fevers, and plague in moſt parts of Europe, except in England. The ſummer of 1651 was hot.

In 1652 appeared a comet. A dangerous ſynochus prevailed in France and a tertian fever in Denmark.

† Of this fever died the Rev. Thomas Hooker, and many others in Hartford. See Neal's Hiſt. N. E. vol. 1. 289. Magnalia, b. 3. 67.

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In 1653 a ſlight earthquake occurred in New-England, in Oct.

The years 1652 and 3 were remarkably dry in England, and in 1654 public thanks were ordered for a ſupply of rain.

Mercurius Politicus.

In 1654 the plague made its appearance in Denmark. Some ſevere epidemic had prevailed in New-England; for in the ſpring of 1654 a general faſt was appointed by the government of Connecticut, one reaſon aſſigned for which was, "the mortality which had been among the people of Maſſachuſetts." What the diſeaſe was, I am not informed.

Trum. Hiſt. Con. 225.

In 1655 occurred the ſecond epidemic catarrh, recorded in the Annals of America. The following is the account of it in Hubbard's Manuſcript, p. 285.

"In 1655 there was another ſaint cough that paſſed through the whole country of New-England, occaſioned by ſome ſtrange diſtemper or infection of the air. It was ſo epidemical, that few perſons eſcaped. It began about the end of June. Few were able to viſit their friends or perform the laſt teſtimony of reſpect to any of their relations at a diſtance. Of this died Mr. Nathaniel Rogers, miniſter of Ipſwich."

See alſo Magnalia, b. 3. 108.

It will be obſerved that this epidemic commenced in the heat of ſummer, and that its invaſion was ſudden and univerſal. In November 1655 occurred an earthquake in South-America.

Of the ſeaſons in America I have no account; but in Europe the winter of 1654-5 was extremely ſevere. The rivers and harbors in Holland were all made faſt with ice; a ſeries of ſnow ſtorms took place in April, and as late as the 19th there was a ſevere froſt at Bruſſels.

See Mercurius Politicus, a London paper for 1655.

In March 1655 was an eruption of Veſuvius; it was very ſickly in the north of England; and there were great tempeſts of wind and hail in 1654 and 5.

In 1654 the plague appeared at Cheſter in England; but did not become epidemic; owing, it was ſuppoſed, to the precaution of confining the diſeaſed to their houſes.* At the ſame time

* This may poſſibly have been the caſe; but it is probable the opinion is not well founded. See this point conſidered in the 16th ſection.

MYASTHENIA GRAVIS.

By W. D. ALSEVER,

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Myasthenia gravis is a rare disease marked by paresis and rapid tiring, with lymphocytic infiltration in muscles and other tissues.

The following case will illustrate this disease:—

F. H., 59 years, physician doing active general practice; wife and five children well; mother well aged 83; father died at 78 years of pernicious anemia; one brother died at 23 years of traumatic myelitis; one brother died at 48 years of appendicitis; one sister and two brothers living and well; both grandfathers lived to be over 70 years, one of them dying as a result of hypertrophy of the prostate; both grandmothers lived to be over 70 years, one of them dying of circulatory failure and the other of strangulated hernia; one paternal aunt died at 45 years of some acute infectious disease, another died at 80 years of diabetes and three others lived to be over 70 years (cause of death unknown); one maternal aunt died because of miscarriage, another died at 76 years of apoplexy, a maternal uncle died of typhoid, and one uncle and one aunt are living and well. There have been no congenital abnormalities in the family.

Dr. H. has carried on a heavy general practice for thirty-five years. He is more than usually sensitive, worries much and has habitually sacrificed himself for others. He had the usual childhood diseases without complications or sequelæ. As a young man he was subject to attacks of abdominal pain which continued until 1886, when he had appendicitis, without operation. He has chronic constipation and takes a laxative daily. Twenty years ago he was kept from work one month and was partially incapacitated for three months because of supposed heart weakness. At

that time his usual pulse rate was 120, and he could not walk across the street without developing dyspnœa. He was nervous and he had tremor and loss of weight, but no goitre, exophthalmos, diarrhœa, sweats, flushes of heat nor œdema. The sickness developed gradually while he was working hard and gradually went away. He has had many pains during his life, especially in the precordium, back and joints. For the past ten years the precordial pain, if severe, has led him to be still. He has had frequent sore throats, many of them being tonsillitis. He has abstained from alcohol, but has smoked excessively. He has had no venereal disease.

In the summer of 1914 recurring attacks of pain in the right malar region began and in the summer of 1915 all upper teeth except the two last molars were extracted. One tooth on the right side lead to an abscess from which a noticeable amount of pus ran out at once and which continued to discharge for two weeks. Many of the roots of the other teeth were found inflamed. Following these extractions there was considerable but not complete relief from pain in the face. Beginning about three months before these extractions and continuing after them Dr. H. noticed unusual fatigue late in the day. During this time he practiced medicine as usual averaging twelve office calls and twelve house calls daily in addition to considerable obstetrical work. This situation remained unchanged until three months later—the fall of 1915—when his brother developed appendicitis. During the week before his brother's death Dr. H., at the end of each day's work, motored thirty miles, spent the night in attendance on his brother, usually getting no sleep, and returned early each morning to carry on his practice. The physical fatigue of this experience was necessarily great, and, because of his personality, Dr. H. undoubtedly suffered more than the usual mental anguish. It was during this week of great mental and physical strain that drooping of the right upper eyelid was first noticed. During the three and three quarters years which have elapsed since then ptosis has varied much in degree but has

never been absent. There often has been ptosis of both upper lids but always more marked in the night. During the following winter (1915–1916) Dr. H. had good and bad intervals, but nevertheless became weaker and by the spring of 1916 was unable to practice medicine at all. At that time he felt most comfortable when lying still with his eyes closed. Vision, especially distant vision, was dim, blurred and sometimes doubled but could be greatly improved by holding up the lids. He was not relieved by changes in glasses. The only abnormality his oculist ever detected was varying weakness of the external eye muscles. If he walked about he first felt heavy in the eyes and then in the legs. After talking or eating for a few minutes he would lose, perhaps completely, the power to talk or swallow, but would regain his usual power after a short rest. His speech was thick, as if his tongue was swollen or his false teeth misplaced. Expectoration was difficult and sometimes fluids regurgitated into the nose. He was continuously tired in some degree, dizzy at intervals, and he felt that "if I could get rested through the eyes, I would be all right." All active movement, including locomotion, was feeble and he trembled after exertion. He went to bed on the advice of his physician but the weakness increased so that he became practically bedridden. After two months he improved so that he sat up most of the time, took some rides and walked in the house. But during the following summer (1916) he had three marked relapses which kept him in bed for several weeks each. During all this time little effort was quickly followed by paresis of the muscles used, and rest of the used muscles would be followed by gradual return of power. The most susceptible muscles were those of the face, mouth and oro-pharynx. He said: "It tires me to talk, eat or look." After a family Christmas party in 1916 he relapsed again and was in bed for seventeen months. During this period his weakness was profound. I have frequently seen him labor to lift his head from the pillow with his hands, it being impossible to raise it in the ordinary manner. There were many days when the swallowing of one or

two mouthfuls of liquid would exhaust him for hours, when his speech was so feeble and blurred as to be understood only with difficulty, and when his lids drooped so that he could see very little. When strong enough he would sometimes lift his lids with his hand so as to see better and it is still his habit to support his jaw with his hand while talking or eating. His loss of weight was about 50 pounds. During this period there were a number of attacks, often preceeded by swallowing food, in which breathing was extremely difficult but of normal rate. His pulse was fast (160) and feeble; his efforts to use his respiratory muscles were agonizing and temporarily unsuccessful. A fatal termination seemed probable in many of these attacks. He felt as though there was obstruction in the air passages in the neck and sternal region. There was only slight cyanosis. In the latter part of this year and a half in bed he gradually improved and since the autumn of 1918 he has not been confined to bed. His progress has been interrupted by occasional mild relapses, and his symptoms, nearly all of which still persist in some degree, are made worse by overexertion and improve quickly with rest. At present he is living a fairly comfortable life and doing a moderate amount of business, namely about five house calls and seven office calls daily.

Repeated physical examinations have revealed the following constant findings:

A well-developed and usually well-nourished man of 180 pounds, five feet ten inches tall; mental state normal; sensation normal, including the pharynx; deep reflexes normal; no abnormal reflexes nor incoördination; myasthenic reaction of Jolly present; reaction of degeneration absent; general motor weakness varying greatly in degree; ptosis of upper eyelids (especially the right); expressionless face through loss of linear markings and appearance of swelling, particularly in the lower half; pupils equal, round, of ordinary size and usually reacting promptly to light and accommodation; blood normal, including Wassermann test and blood sugar (.166 per cent. at 8 P.M. and

.125 per cent. before breakfast); lumbar puncture showed normal pressure, no globulin, normal cell count and negative Wassermann; urine normal in quantity and quality, creatin absent, creatinin 1.4 gms. in twenty-four hours; thyroid gland not enlarged; x-ray plates show a broad zone of increased density under the sternum and extending a few centimetres to either side of the sternum, hazy at its margins and continuous with cardiac density, while percussion in the sternal region shows a vertical zone of dulness 8 cm. wide which may be an enlarged thymus; heart, lungs, liver, spleen and other abdominal organs apparently normal; pulse usually about 70 and regular; radial arteries soft; systolic blood pressure 140, diastolic 90; teeth normal to the x-ray and apparently in good condition; tonsils large and cryptic, but without abnormal secretion.

There can be little doubt about diagnosis in this case inasmuch as chronic paresis, rapid tiring of muscles, variation in intensity of symptoms and the myasthenic reaction are present, while the following are absent,—fibrillation, muscular atrophy, reaction of degeneration, sensory symptoms and loss of sphincter control.

The cause of myasthenia gravis has long been sought. Since Weigert in 1901 reported lymphocytic infiltration in many tissues (1) and notably in the weakest muscles, this finding has been duplicated in such a large percentage of autopsies that we may regard it as a constant accompaniment of the disease. Lymphocytic infiltration has been found commonly in the thymus gland, but perhaps has no more significance there than in other locations. The occasional faulty involution of the thymus, especially when accompanied by degenerative or malignant changes, has suggested a relationship between thymus disease and myasthenia gravis. But structural abnormality of the thymus is so infrequent (5 per cent. of 180 cases according to McCarthy[1] and 20 per cent. of 56 autopsies according to Bell[2] that it can hardly be considered a factor in most of the cases. Barker states that it is "probable that the internal secretion of

the thymus may exert an important influence on the blood building apparatus. Thus, experimental thymectomy is followed by a progressive diminution in the number of lymphocytes: intravenous injection of thymus juice or implantation of thymus gland will, on the other hand, cause an outspoken lymphocytosis." In the case here reported there was 32 per cent. of lymphocytes and 62 per cent. of polymorphonuclears. Sarcoma of the thymus cannot be the cause of myasthenia gravis for some cases recover, fatal cases have continued from five to twenty years, and Bell[2] reports that out of 73 thymic tumors not associated with myasthenia gravis 61 were malignant. No doubt lymphocytic infiltration of the thymus has been mistaken for sarcoma.

MacCrudden and Sargent[3] observed a low percentage of blood sugar in two cases of myasthenia gravis as well as in other cases of muscular weakness, but the blood sugar in the case here reported is at the upper limit of normal.

Abnormal function of some endocrine gland has been suggested as a cause, but at present it can be neither proven nor disproven. Similarly it is possible that toxæmia originating outside the endocrine glands may be the cause. The association of abscessed teeth with the onset of the myasthenia in this case is suggestive.

That myasthenia gravis is not a pure neurosis is shown by the almost constant finding of widely distributed lymphocytic infiltrations. That it is not dependent on an inherited or familial defect in the nervous system is indicated by McCarthy's report that, among his 182 collected cases, only 20 per cent. gave a history of any sort of nervous disease in the family.

Botazzi made the interesting suggestion that there are two sorts of contractile substance in muscle, a fibrillar which contracts quickly and a protoplasmic which contracts slowly; and that a selective poison reducing the excitability of the protoplasmic substance would produce the symptoms of myasthenia gravis. However, the physiological basis for this theory has not been established.

In the case here reported the somewhat neurotic temperament and the unusual mental and physical strain at the onset of ptosis establish the foundation for a neurosis. The "heart weakness" of twenty years ago, which probably was transient hyperthyroidism, makes disturbance of internal secretions seem probable, while the abscessed teeth suggest still another source of toxæmia. Malignant disease is not probable, for the sickness has now lasted over four years; two years ago a fatal outcome seemed imminent and now the patient is able to work again. There are dulness and opacity to the x-ray in the sternal region which may be due to enlargement of the thymus, but proof of this supposition is lacking.

This case is of interest because of its long duration and because of the striking contrast between the severity and duration of the last relapse and the present good condition. This patient nearly choked to death many times in 1917, and his feeble, emaciated condition with his inability to swallow food made the prognosis very grave. At present he is fully nourished, fairly strong, but tires easily.

There is no curative treatment for myasthenia gravis. Good nutrition is important and at no time is this appreciated so much as during a relapse when swallowing is difficult. However the writer's experience with this case has led him to have profound respect for the ability of rest to control the disease. Each relapse has followed a period during which the patient allowed himself repeatedly to work to the point of extreme fatigue. If he rests as soon as he is conscious of increasing weakness, his improvement is surprisingly prompt and certain, but if he daily exhausts himself he usually pays a heavy penalty. These statements are not made in the belief that rest is curative, but in this case rest is far more powerful than any other treatment which has been used. It seems reasonable that careful avoidance of fatigue would make the life of such patients more comfortable, relapse less probable and the possibility of cure greater.

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SOME LESSONS OF THE WAR IN PULMONARY TUBERCULOSIS.

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It is perhaps too early to draw definite conclusions from the war regarding pulmonary tuberculosis, yet certain incidents connected with this disease in our army suggest lessons which may be considered. These lessons may be brought under the following headings: (1) The diagnosis, (2) the prevalence of tubercle infection, (3) the hygienic prophylaxis.

1. *The Diagnosis.*—Much has been already written on the diagnosis of pulmonary tuberculosis and its difficulties and much I may relate will seem time-worn. Specialists in this disease were afforded an opportunity on a large scale to rid our army of men with manifest tubercle. Seventy-three thousand men were excluded on account of pulmonary tuberculosis from the first two and half million men, and ninety thousand were excluded from the four millions mobilized. (In 5,700,000 called to the colors 2,000,000 or over 30 per cent. were rejected for one cause or another.) The fact was possibly overlooked that the incidence and death rate of the young manhood of twenty-five years—the average age of our soldiers—are much less than they used to be. The yearly death rate at twenty-five years per million of civilian population of that age should be about 1,800 and the incidence, therefore, would be around 7,000 to 9,000. The rejection of about 30,000 men from four millions instead of 90,000 would have been possibly more correct. It seems evident that our experts erred on the side of making a positive diagnosis more than three times as frequently as they should have. In spite of this over zeal, there have been more

than 1,200 deaths from pulmonary tuberculosis in the army, 8,500 have been admitted to army tuberculosis hospitals with possible tuberculosis, and at present the death rate from this disease is heading the weekly morbidity returns. In addition over 1,200 possible cases have been detected in the first two million men who have been demobilized. From the work of these examinations two conclusions may be drawn, (1) too many men were diagnosed as tuberculous, (2) it was impossible to detect the men who in a few months would break down with this disease.

Glover by a more thorough examination and study of patients admitted to the Birmingham Sanatorium, England, by well-qualified physicians, discovered that sixty per cent. of the admissions were non-tuberculous. Early in the war men were invalided home from France for pulmonary tuberculosis with a similar percentage of error in diagnosis. The French themselves, in the early part of the war, made similar mistakes. It can be safely concluded, therefore, that unless tubercle bacilli are found in sputum, that the early diagnosis and recognition of cases of pulmonary tuberculosis, in spite of all refinements of physicial diagnosis, x-ray study and laboratory tests, is not an exact science. It is indeed a difficult point to decide that tuberculosis may have the victim rather than that the victim may have tubercles. It is possibly little comfort to learn that if the experts in tuberculosis made many mistakes those in heart diseases possibly made more, and it was a strange experience for these physicians to learn that possibly only one man in thirty (at 25 years) found with apical systolic murmurs, really had organic heart disease. Too little familiarity with normal variations may account for many of these mistakes in clinical examination. Medical students and physicians need more intensive study of normal individuals—subjects possibly difficult to procure in medical schools and hospitals. Judging by the records of many examiners entirely too much stress has been laid on such physical signs as D'Espines, Kronig's isthmus, lagging apices, etc., re-

sulting in an improper interpretation of the case. Similarly the improper interpretation of muscle râles, sternal râles and marginal râles caused many unnecessary mistakes. The attempt at exclusion of manifest tuberculosis, though erring in the manner indicated, was certainly worth while as can be illustrated by the figures of Cabot from Base Hospital No. 6 at Bordeaux. In 21,738 patients passing through this hospital only 51 were found with positive sputum, and 12 cases were found at autopsy. Three fifths of these cases occurred in the first 7,000 admitted—mostly stevedores who had not had expert examination—only one case was found in patients numbered from 17,000 to 21,000.

Mistakes in Diagnosis.—At the cost of repetition I wish briefly to recall a few of the chief errors. In spite of the warnings of our French colleagues Rist and Sergent, we made an overwhelming number of mistakes through inability to recognize chest conditions due to or accompanying naso-pharyngeal diseases. We excluded from service and we passed along to the hospitals almost innumerable "coughers" under the heading tuberculosis, of tracheo-bronchitides, or as Sergent puts it, the bronchitides of "damp feet and obstructed noses." Such diagnoses were frequently abetted by the roentgenologists, whose attention would be called to healed tubercles and exaggerated bronchial trees, when their efforts should have been directed by clinicians to taking plates of the nasal sinuses. Too much stress cannot be directed towards the need of x-ray pictures of these sinuses and to the careful investigations of the accessory sinuses by rhinologists when chests are found with abundant râles, but the sputum is repeatedly negative to tubercle. Many abortive bronchopneumonias occurred often in men who were not admitted to hospitals, and these and the more severe pneumonias were left with chronic coughs, bouts with fever, lagging apices and the usual signs and symptoms suggesting pulmonary tuberculosis. The old rule of apical lesions indicating tubercle, and basal lesions indicating residual pneumonia fractions was often found wanting. Steiner in Base Hospital No. 15 at Chaumont, by

taking frequent serial pictures of the pneumonias, found that the upper right lobe would usually be the first to be attacked, and later the lower left lobe. Serial plates should be taken in all suspected chest cases in which the sputum is negative. In this way the residual fractions of the pneumonias so often taken for cases of tuberculosis will be seen to gradually disappear.

The errors in diagnosis of pulmonary tuberculosis admitted to our three observation centers in France, were in order of frequency.

1. Pneumonias of delayed convalescence; often complicated by nasal sinus infections.

2. The bronchitides, frequently complicated with nasal sinus infections (several cases of bronchitis were found to be due to the Klebs-Loeffler bacillus).

3. Gastrointestinal conditions with loss of weight, cough asthenia etc.

4. Hyperthyroidism.

5. Psychoneuroses including effort syndrome.

6. Syphilis of lung and new growth.

Strepthothrix conditions were not found.

Neither mustard gas nor excessive cigarette smoking appeared to precipitate cases of pulmonary tuberculosis although both would cause mistakes in diagnosis. In the first 700 tuberculous soldiers we returned to the United States of which 84 per cent. had sputa positive to tubercle, only 20 gave a history of being gassed, and we had to take the soldier's word for this possibility. Of these same men returned home, 32 per cent. were non-smokers, 31 per cent. were pipe smokers or mild cigarette smokers who did not inhale and 37 per cent. were classed as heavy cigarette smokers. Approximately only 5 per cent. of the men in the American Expeditionary Forces were non-smokers.

It will be of interest to briefly state here that following the mild influenza of April and May, 1918, and the more severe epidemic of September and October, 1918, a decided increase in the number of positive cases of tuberculosis occurred. Trauma

and gunshot wounds of the chest did not appear to bring about a development of this disease. Over-fatigue of certain divisions usually resulted in an increased number of cases of pulmonary tuberculosis coming from those divisions.

Pleurisies with Effusion.—Only 9 per cent. of the 700 cases referred to gave a history at some time of pleurisy with effusion. Very many cases of pleurisy with effusion were seen in the American Expeditionary Forces. Guinea pigs and mice were not available for tests of the fluids removed. We received the impression that very many of these pleurisy cases were not tuberculous in origin. In some streptococci were found in the fluid removed. It was exceptionally rare to find a tuberculous deposit in the lung opposite to that affected.

The Diagnosis during the Development of Pulmonary tuberculosis.—In all armies it seemed impossible that early diagnosis of pulmonary tuberculosis could be made. The same complaint came from all that when men were discovered with this disease, they were in a somewhat advanced condition. Of the 700 positive cases reported, referred to above, the disease was present in the right upper lobe in 140 men, in the left upper lobe in 80, and in all the others the disease was disseminated.

The types of pulmonary tuberculosis seen were: (1) Parenchymatous or alveolar type, (2) peri-bronchial or para-vertebral type, (3) miliary type.

Probably nearly 60 cases of the miliary type were recognized and confirmed at autopsy. X-ray evidence in one soldier demonstrated a complete recovery from a slight ancient miliary condition. One distressing case occurred in a young lieutenant immediately following the removal of his tonsils, and death occurred within five weeks.

In a recent publication by Colonel Bushnell an analysis was presented of 984 tuberculosis patients studied by the roentgenogram. 394 had definite para-vertebral or peri-bronchial or the lymphatic type. 2 cases alone showed tubercles present at the apex without peribronchial shadows. 82 showed para-

vertebral tuberculosis alone as revealed by thickened lines with studding extending towards or to the apices. In 39 of these eighty-two the lines had not reached the apex. 45 of these eighty-two cases gave no definite physical signs.

All 82 soldiers showed at some time symptoms such as cough, expectoration, pleurisy or hemorrhage, and 80 had at some time tubercle bacilli in their sputum.

Of 62 incipient cases 37 had no physical signs, yet all had, or had had, symptons, and all except one had, or had had, positive sputum.

All 62 cases, except 2, showed para-vertebral tuberculosis above the hilus, and it was considered, therefore, that one was dealing with conclusive evidence of tuberculosis of the deep lung in its early phases. Colonel Bushnell concludes that incipient tuberculosis is not incipient, but is detected when the deep peri-bronchial tuberculosis invades the superficies, or, in other words, when tuberculous lymphangitis or peri-bronchial pneumonia extends into a larger tuberculous broncho-pneumonia involving the cortex of the lung, the so-called primary tuberculosis.

Heise and Sampson also called attention to these different types of pulmonary tuberculosis. They term the peri-bronchial or para vertebral the closed lymphatic type, and state that in these cases hemorrhage is less frequent, tubercle bacilli in the sputum are less frequent, the complement fixation test is less apt to be positive, and the Von Pirquet reaction is apt to be less positive.

The terms "closed" and "open" seek to compare the conditions of pulmonary tuberculosis to those of tuberculosis of joints.

Rist argues against accepting the clinical term closed tuberculosis stating that every form of tuberculosis should have tubercle bacilli in the sputum at some time or, other if so diagnosed.

Sergent does not accept Rist's argument and states that the difficulties in the correct diagnosis of these chest cases in the army come under two headings: (1) The difficulty of diagnosis

between the true and false cases of tuberculosis, (2) the difficulty of diagnosis between tuberculosis in evolution or active tuberculosis, and that of "extinguished" tuberculosis. Sergent claims that even the presence of tubercle in the sputum does not settle the last question and that the first question cannot be decided alone by negative sputa examinations.

It is safe to state that one of the lessons of the war in the diagnosis of pulmonary tuberculosis is that constant and prolonged observations are necessary, both in regard to the study of clinical as well as of physical signs, and that the diagnosis cannot properly be made without such study when the sputum is negative to tubercle. Clinicians and students of pulmonary tuberculosis should, as Theobald Smith has so insisted, look at the problem more from the parasite point of view. In order to perpetuate their species, parasites must have access to and egress from their host. We may, in the language of the day, look at the tubercle bacillus as desiring "a place in the sun," domination and not destruction of "colonies" where it can continue its "militarism." As one enemy of his type has so recently been vanquished, let us now concentrate on the destruction of this other terrible foe, the tubercle bacillus. As Theobald Smith explains, the tubercle bacillus is "tuned-up" to the human adult lung; all other forms are aberrant. It is not yet decided how the tubercle bacillus reaches the lungs, whether by the inhalation route (favored by French authorities), by the intestinal route (favored by German authorities), or by the nose and throat, especially through the tonsils, a route which may in time be considered more important. Possibly all routes lead to the hilus where we find so often the tubercle bacillus established. To achieve its "national aspirations" it has probably on account of anatomical and physiological chest conditions established definite routes of egress. It is of especial interest that surgeons like Robinson have in recent years traced tuberculosis of the ribs and sternum to pleural and mediastinal tuberculous deposits. We have seen cases where the tubercle bacillus has succeeded in

escaping from the chest by the surgical as well as the medical routes.

Opie has attempted to show that the apical infection of adults is a new infection probably from without, and not necessarily connected with the focal infection of childhood. Opie demonstrated that the lymphnodes connected with the apical infection were usually not caseated, whereas those connected with the focal infection of childhood were usually caseated. Opie compares these findings with the well known results of Koch in the inoculations of guinea pigs. Opie fails to explain, however, why tuberculous lesions of adults are chiefly in the upper lobe. In regard to the focal infection of childhood, Ghon found the deposits in the proportion of five for the lower lobes to seven for the upper. He pointed out that the inoculation points in the lung might entirely disappear, leaving only the hilus lymphnode infection. In 17 per cent. of tuberculous children, Ghon found at autopsy a bronchial node breaking or broken into a bronchus. Harbitz found a similar condition in 20 per cent. Tenderloo has most thoroughly studied the mechanical forces which operate the chest. In brief, it is pointed out that above the bifurcation of the trachea, there is very little movement of the chest, and that the lymph flow in the upper lobes is very sluggish. On account of the pumping action of the diaphragm, the lymph flow in the lower lobes, especially in the peribronchial lymph-spaces which are perpendicular to the diaphragm, is very swift. The para-vertebral region from the fifth rib upwards would also seem to be a region of biochemic susceptibility to tubercle.

Should we accept the ruptured lymph node theory as suggested by Ghon's work, the purulent material scattered by cough throughout the lungs would be rapidly swept away from the lower lobes, the cleaning process there being so great, whereas the material forced to the apex would stand a very much better chance of developing infection. The more probable theory of the tubercle bacillus, travelling from the hilus by peri-bronchial

lymph-spaces to the upper lobes on account of the more sluggish lymph movement, fits in best with the studies of Colonel Bushnell as reported above. Opie himself, accepts as possible the reversal of the lymph stream if it is blocked in its course. There can be no doubt that the apical infection of adults increases with age, although active tuberculosis does not necessarily. After seventy years, fifty per cent. of autopsies revealed definitely tuberculous upper lobes.

In view of the difficulties in the diagnosis and detection of pulmonary tuberculosis which I have briefly reviewed, a recommendation was made to the Surgeon General, that if possible fortnightly clinical and x-ray examinations should be made on several thousand soldiers in an attempt to ascertain the mode of development of pulmonary tuberculosis. The studies of such serial plates would be of the greatest scientific interest and should lead to important help in the art of diagnosis.

2. *The Prevalence of Tubercle Infection.*—A remarkable opportunity was offered in the American Expeditionary Forces for the investigation of tubercle deposits in the bodies which came to autopsy. Unfortunately few pathologists were found who were thoroughly alive to this opportunity. All autopsies—many thousands—reported in the American Expeditionary Forces, agreed on one finding, namely the small percentage of macroscopic tuberculous lesions. I will quote you the observations made by a few of the pathologists, most painstaking in their search for tubercle as reported at the tuberculosis conference of the Research Society of the American Red Cross in Paris last November.

Major D. J. Glomsett: Out of 308 autopsies I have performed at Base Hospital No. 15 only 6 deaths resulted from tuberculosis. I found about the same proportion in the autopsies at a cantonment in the United States. I am struck with the rarity of deaths from pulmonary tuberculosis. It is extremely interesting that such a small percentage of our soldiers show any evidence of tuberculosis at all. In my experience only 44 have shown any

lesion whatever. Tuberculous lesions are certainly rarer in young men than they are in men over fifty. Probably eleven per cent. of our autopsies have shown definite deposits of tubercle, whereas in men of over fifty, one would certainly find 60 per cent. with deposits. Such evidence hardly supports the view that all infection is in childhood, and I feel it may be as easy to become infected with tubercle in later life as with other diseases. The vast majority of my cases have shown what I call a primary focus in the lung, with a secondary deposit in the hilus. To my mind, tuberculosis travels from the lung to the mediastinum. I have only seen one case in which I did not succeed in finding a primary focus in the lung. I have found the lesions in the upper lobes and in the lower lobes, especially on the left side, as well as in other parts of the lung.

Major H. E. Robertson (communicated): During the first year of the war, I worked in Germany at Freiburg with Aschoff, and I was struck with the high percentage of lesions of tuberculosis found in the German soldiers. In 100 autopsies which I made for Pick, 70 per cent. revealed the deposits in the lungs or nodes, especially in the nodes at the bifurcation of the trachea. It has seemed quite remarkable to me that in making personally 600 autopsies and in supervising some 4,000 on our soldiers I have been unable to detect deposits of tubercle in even as much as 25 per cent. of the cases.

Captain A. N. Desjardins (communicated): Out of a series of 82 deaths from all causes, I have found gross evidence of tuberculosis in 20, as shown in the following chart. A point worthy of note is that, with one or two exceptions, the lesions were in the left lung and usually in the lower lobe.

	Acute.	Fibrous.	Chronic.	
			Calcareous.	Miliary.
Lungs	0	1	11	0
Tracheo-bronchial lymphatic nodes	0	0	7	0
Liver	0	0	0	4
Spleen	0	0	0	2
Mesenteric lymphatic nodes	0	0	1	0

Captain E. C. Ernst: I have some x-ray pictures to show of some investigations made by Captain Eugene Opie and myself on the bodies of British casualties. Captain Opie carefully removed the thoracic contents, exclusive of the heart, and also the mesentery. These were placed on oiled paper on an x-ray plate and a soft picture was taken. The results were most interesting. 70 per cent. of the British soldiers revealed calcified tubercle deposits in the nodes of the mesentery. Many of these could only be found later by most careful search. In about 15 per cent. deposits were found as shown by these negatives, and later confirmed by dissection in the lungs or tracheobronchial lymph nodes as well as in the mesentery. Very few lungs and mesenteries were completely negative. About 15 per cent. of the lungs or tracheo-bronchial nodes revealed deposits when the mesentery was completely negative. It has been a curious fact that in our recent work in autopsies of American soldiers only 35 per cent. have shown such deposits in the mesentery, and only 15 per cent. have shown deposits in the lungs and not in the mesentery.

Somewhat contrary to Robertson's observations is a publication by Oberndorfer stating that he detected only 10 per cent. of deposits in some German casualties, the number of which is not stated.

Microscopic examinations and guinea-pig inoculations were not made by our pathologists. It is probably true that in many instances the cervical lymph nodes were not carefully examined. It must be considered also that these pathologists had had not frequent occasion or opportunity to conduct autopsies on many young adults. On the other hand, this has possibly been the first occasion when autopsies have been made on large numbers of country dwellers. It was this same element you will recall, that succumbed so readily to measles and pneumonias in the cantonments. Von Pirquet and other tuberculin tests have been known for sometime to yield fewer positive reactions in dwellers of country districts than with city dwellers. The opportunity for infection is known to bear a direct ratio to density of population.

About 500 soldiers died in France of a rapid form of tuberculosis. Twice as many of the 700 cases quoted came from the service of supply where men were distributed in cities and villages as from the front. 14 per cent. of our returned cases were negroes, whereas, possibly not 5 per cent. of the troops were colored. The negro mortality at the age of 25 is figured in cival life as being five times that of the white. An incidence of tuberculosis, greater than in other sections among some negro stevedores at Bordeaux, led us to examine 3,500 of these men. Only one case with positive sputum was discovered, 22 were marked for observation.

From the reports of the pathologists quoted, it would seem justifiable to consider that a much smaller percentage of our young adults may have deposits of tubercle than we had been led to suppose. It has been considered heretofore, that 75 per cent, upwards of our fellow beings were infected with tubercle. Such infection has been considered as a protection against the development of pulmonary tuberculosis. From the pathological findings quoted it would seem that instead of 75 per cent. of young adults being protected through early deposits of tubercle possibly 75 per cent. are really without such protection and so would be vulnerable to infection.

The careful combing out of our camps of all cases of tuberculosis carriers, would minimize the infection with this disease under the conditions of mobilization. Have some of our men therefore, contracted this disease when abroad? We kept careful tabulations of the occupations and home centers of these tuberculous soldiers. Curiously we had to return more tuberculous soldiers from Texas than from Pennsylvania, and more from Kentucky than from Massachusetts. In general the larger proportion were from agricultural states and farmers headed the list of occupations.

There are two possibilities which only time and careful studies of the autopsy protocols can determine. (1) Did cases of primary infection occur in the American Expeditionary Forces? (2)

Were men infected from without with tuberculosis who were considered to be protected by a former infection. I do not believe that at the present time either possibility can be absolutely denied.

3. *The Hygienic Prophylaxis.*—I shall only mention in this regard that which seems of the greatest importance, namely—fresh air. It has been well said that the enjoyment and the employment of fresh air is not instinctive to the human race. It has been a revelation to me to see this—probably the most important prophylactic measure we have—so generally ignored. Men huddled around stoves in shut-up tents in Texas, men stuffing their clothes in ventilators and port holes on transports, nurses and ward masters keeping their wards so stuffy that to those who worked in outdoor tuberculosis shelters and barracks, the atmosphere resembled that of monkey houses; medical officers of exalted rank sleeping with hermeticaly closed windows and lastly the Army of Occupation housed in comfort in Germany sleeping and living with sealed windows. Surely the campaign for fresh air has fallen on deaf ears and needs new activation.

Splendid food and good warm clothes all our soldiers had, yet they avoided fresh air if they could, as the French soldier avoided water. Bodington, the originator of the fresh-air cure for consumption, closed his institution for the air cure at Erdington, England, as a result of the sarcasms and jeers of his confrères and their patients. Bodington transformed his institution into an insane asylum which led one of his persecutors to remark that Bodington ended in the same way he had begun. Advocates of fresh air still seem to be regarded in this class. Shakesphere, as usual, had anticipated Bodington in his "Give him air, he'll straight be well" and the amplification of this,—give them air, they'll not get sick—should be planted again and again in the minds and memories of all.

Colonel Bushnell: The importance of obtaining a correct answer to the question raised by Colonel Webb is very great. If it is true that a large percentage of the soldiers of our army are without previous contact with the tubercle bacillus, and have therefore no immuni-

zation whatever against tuberculosis, they are in danger of epidemics of primary tuberculosis and the situation is liable at any time to assume a gravity which would make the epidemics of other diseases through which our army has passed seem trivial in comparison. However personally I do not believe that the situation is as bad as Colonel Webb thinks. In the first place while we do not know the number examined by Major Robertson that of Major Glomsett's observations was relatively small, some fifty odd as I recall it. We have Major Glomsett's 16 per cent., Major Robertson's 25 per cent. in our soldiers and 70 in German soldiers against which we can set off Oberndorffer's 10 per cent. in German soldiers and finally we have Major Opie's 50 per cent. and more of positive results from his study of parenchymatous pulmonary lesions found by the x-ray. Which of these is the true percentage? We do not know, probably none of them are. The numbers from which the percentages are obtained are too small to give results from which general conclusions should be drawn. It does not appear that Majors Robertson and Glomsett used the microscope in making their researches. If they did not their results can not be compared with those of Naegeli, for example, and Naegeli's results in his first series even with the microscope were only about 40 per cent. positive. It was only after long practice that he attained the 97 or 98 per cent. of his last series. Therefore too much weight should not be given to the small percentage of positive findings at autopsy. Indeed, how do we know that the highest immunity may not be found in the cases which have so restrained the growth of the tubercle bacillus as to prevent all visible parenchymatous and glandular lesions? Oberndorffer in fact suggests that that there may be a tuberculous immunity which does not leave a histological record of its presence. Now as to the alleged acuity of tuberculous disease. Everyone will admit that immunity is generally completely lost before death in uncomplicated cases in which the cause of death was tuberculosis, there being an antemortem generalization of tuberculosis it may be with macroscopic foci or with those which are only revealed by the microscope. The fact that a soldier has died of miliary tuberculosis or of tuberculous meningitis is not a proof that the case is one of primary tuberculosis. The distinguishing characteristic of primary tuberculosis is that there is no immunization of the glands so that a well marked adenitis regularly accompanies every extension of the tuberculous process. The glands may become enlarged and may suppurate occasionally as a feature of an imperfect immunization, the tuberculosis nevertheless pursuing a chronic course. Enlargement of the glands per se is not evidence of primary tuberculosis, but the absence of enlargement of glands of the parts newly invaded is a proof that the disease is not primary. Unless then these gentlemen can show that such adenitis was present in the soldiers autopsied by them, I would not admit that they had found primary tuberculosis.

DISCUSSION.

Dr. Pottenger: The paper of Dr. Webb brings up for discussion the question of phthisiogenesis. It seems to me that it is well established that the chief time of infection in tuberculosis is early childhood. Resulting from this early infection there is a change in the body cells which makes their behavior toward the tubercle bacillus very different from the cells of those who have never been infected. This is according to Koch's experiment on the guinea pig. In primary infection when bacilli gain access to the tissues they pass through them readily and go to the lymph glands to infect them. In secondary infection the tissue cells are so changed that a reaction takes place between the tubercle bacilli and cells at the point of contact, and their progress in the tissues is hindered to such an extent that the main reaction is local; and the neighboring glands remain free from infection, or are infected only slightly. This principle is shown in our study of clinical tuberculosis. While in the child a very small lesion in the lung may be followed by enormous infiltration and caseation of the glands; in tuberculosis of the adult where large portions of the lung, or of both lungs are involved there may be no appreciable involvement of the glands. The same is true of the larynx and intestines, both seem to be surface infections. The bacilli in passing over the surface become enmeshed in the superficial cells and while they become implanted there producing an infection, the infection does not spread to the lymph glands but remains localized. Therefore, it seems to me that the adult is comparatively free from danger of infection from without and that tuberculosis in the adult population is at least in the very large proportion of cases an extension of an original focus within the body. I can not see that our soldiers were subjected to any great risk of becoming infected while abroad. It seems more probable that those who developed clinical tuberculosis while in the service had a mobilization of the bacilli which had previously been implanted in their bodies.

I agree with the position that Colonel Bushnell has so well stated in his discussion.

REPORT ON THE WORK AS SEEN IN CERTAIN SPHERES IN THE OFFICE OF THE SURGEON GENERAL.

By CHARLES W. RICHARDSON.

Just before the declaration of war, April 6, 1917, I had been appointed a member of a committee of three, representing the American Otological Society, American Laryngological Association, and the American Laryngological, Rhinological and Otological Association for the purpose of conferring with the Surgeon Generals of the Army and Navy to ascertain wherein the members of these bodies could be used to the greatest advantage in these services, and whether they might be used along the line of their specialties, in case of active hostilities. This committee was to present its conclusions to the General Medical Board, Council of National Defense.

This committee consisted of Dr. Harris P. Mosher of Boston, representing the American Laryngological, Rhinological and Otological Association; Dr. Burt R. Shurley, representing the American Laryngological Association; and Dr. Charles W. Richardson, representing the American Otological Society. At the first meeting, held in the City of Washington, March 31 and April 1, 1917, certain conclusions were formulated and presented to the Council of National Defense. At this meeting Dr. Charles W. Richardson was made chairman. At this time I requested that I be removed from the old medical reserve corps to the new Officers Reserve Corps. On June 23, 1917, the committee made a request of the General Medical Board, Council of National Defense that it be created a special section on Oto-laryngology of the Division of Surgical Specialties of the Council of National Defense. This request was granted.

This committee was the second organization of specialties

accepted and put into action by the Medical Section of the Council of National Defense. The Ophthalmological Section had been organized and accepted several weeks before that of the Oto-laryngological.

The activities of this section consisted in the listing of the known specialists in these branches, preparing and sending out questionnaries, and maintaining a card index and files according to the replies to the questionnaries. Through this method we obtained the request or consent of several hundred specialists, practising oto-laryngology to enter the service as members of the Medical Reserve Corps, U. S. A.

The performance of this duty may appear in statement very simple, but in actuality it entailed quite a laborious effort to bring it to its complete fulfillment. In this work 5,000 questionnaires were addressed and mailed. Over 3,000 replies were examined and classified. The Ophthalmologic and Oto-laryngological Sections worked in unison, and in many important issues worked together to the great advantage of both sections. Numerous meetings of the combined sections were held during the months of July, August, September and October. During the month of July, 1917, the Division of Surgery of the Head was created in the Surgeon General's Office with Lieutenant Colonel Theodore F. Lyster as chief. The personnel of this division was made up of members of the section of Ophthalmology and Oto-laryngology of the Council of National Defense—Major Nelson M. Black, Ophthalmology, Major Harris P. Mosher, Oto-laryngology, Captain V. D. Blair, Oral-plastic Surgery, and Captain Bagley, Brain Surgery.

The reader of this paper was engaged upon various activities connected with the Surgeon General's office, both as an active and an inactive officer from this period until October 24, 1917, when he was assigned to active duty as major in charge of the Section of Oto-laryngology, Division of Surgery of the Head, during Major Mosher's absence overseas.

Gradually all of the men represented in the two above

mentioned sections were brought into the office of the Surgeon General, serving in various capacities with the Division of Surgery of the Head. The complete transformation was accomplished October 30, 1917, and while the section theoretically existed as a sub-section of the General Medical Board of the Council of National Defense, they were functionating as officers of the United States Army, assigned to the Surgeon General's office.

At the time of my induction into the office of the Surgeon General, the presiding genius of this important bureau was our distinguished colleague, Major General William C. Gorgas. The officers in charge of the various divisions were men distinguished in the regular service for their organizing and administrative ability. Some few of the special division, and as assistants in all divisions, were men famous in medicine who had been inducted into the service from civil life. How well all of these men lived up to what had been expected of them is thoroughly demonstrated by the smooth running of the office and the wonderful results attained by them. The collective work and the attended results will only be fully told when the surgical and medical history of the war is published. It would be almost impossible for me to recount wherein the best service had been rendered; where courtesy and consideration had been shown to the greatest extent to the medical officers from civil life, whose lines fell in this office. The appreciation of coöperation, the willingness to assist in the details of duty, the patience displayed and the courtesy of the regular officers to the medical reserve officers was unusual. As the reserve officers quickly mastered the details of the office, the regulars in many of the divisions were sent forward to the front "over there," with the resultant advancement of the reserve officers.

At the many conferences the opinions of the reserve officers were eagerly sought and the advice when sound and logical quickly acted upon. Amicable friction at times, differences of opinion on important topics and actions prevailed, but after thorough consideration that which was for the best, and that

which was right always gained action. It would be impracticable for me, in a short paper as this must necessarily be, to go extensively into the various divisions of the Surgeon General's office and give an interesting review of their workings. It would probably interest some of you to hear of the purely medical, surgical and reconstructive work, but I shall not refer to these, rather limiting my further remarks to the four divisions which you are not as well acquainted with, and which did such efficient work, that is, the administrative, hospital, laboratory, and finance and supply division. The remaining portion of this article has been furnished me through the courtesy of Colonel Furbush, Administration; Colonel Smith, Hospital; Colonel Kussell, Bacteriology; Colonel Darnall, Finance, and have been included in this paper without abridgement, or alteration.

Administrative.—When war was declared, the Surgeon General's organization occupied a few offices in the State, War and Navy Building, in charge of about six officers, and with a force of about one hundred civilian clerks. By the end of the year, 1917, the staff had increased to 165 officers and 535 clerks, occupying the whole of five buildings and parts of two others. At the present time, the same organization has grown to a point occupying 225,000 square feet of space, with over two hundred and fifty officers and nearly thirteen hundred civilian employees.

The administrative work has grown proportionately. In April, 1917 a total of three hundred communications, incoming and outgoing was a good day's work. At the present time this centralized Incoming and Outgoing Mail Room handles a total of over 7,000 communications a day, including telegrams.

Under war pressure as many as 6,000 telegrams have been received in the Surgeon General's office in a single day.

The old system of record keeping was revised in September, 1917, and a complete new system installed which provides for the handling of mail of a predetermined schedule and the centralized filing of all communications at one point within eight working hours after the communication has been acted upon. In April,

1917, the Surgeon General had part use of a horse and delivery wagon for mail, supplies and other purposes. Now the office maintains five motorcycles, two automobile delivery trucks with three other automobiles, all of which are in constant use.

The equipping of the organization has kept pace with its growth, and at no time has the organization found itself without equipment and civilian personnel to meet every demand.

The organization maintains a force of experts studying and analyzing the detailed operations as they relate to all branches of the work with the idea of conserving and harnessing up the clerk power. Lectures are held for new clerks and the clerks individually studied and matured as quickly as possible. Under the old system it took six months to make a file clerk. Under the present system a new file clerk is matured in three weeks.

The organization is independent in all light carpenter repair work and printing, maintaining separate organizations for these purposes.

The spirit of the clerks is watched constantly and stimulated, developing team play and co-operation.

At the beginning of the war, there was in service in the Medical Department, U.S.A., 1,085 medical men. There were 950 men in the Regular Medical Corps; 135 graded as 1st lieutenants in the Medical Reserve Corps, making a total of 1,085 Medical Officers. There were also 117 in the Dental Corps.

At the present time there are 28,449 medical men in the service, divided as follows:

922 in Regular Medical Corps.
28,449 in Medical Reserve Corps.
1,220 in Medical Corps, National Guard.

The Dental Corps at present consists of 5,829 Dental Officers, i.e.,

224 in Regular Dental Corps.
4,042 in Dental Reserve Corps.
244 in Dental Corps, National Guard.

At the beginning of the war, recognizing the fact that some of the most notable advances in medicine, particularly in preventative medicine, have been achieved by the specializing of certain men, it became the policy of the Surgeon General's office to utilize the services of the specialists as far as possible in the line of his specialty. As soon as this became known, the specialists of the country dropped their reluctance to enter the service.

With the advent of recognized sections for the various specialties, the older classification of the army medical work into two divisions, Surgery and Medicine, was superseded by eight divisions covering the various special branches of medicine and surgery, each having at its head a man experienced in the given specialty. According to this arrangement, when a man is assigned to a cantonment hospital, his work is in line with his special training and experience. A man who has devoted his entire time to the practice of diseases and surgery of the brain, for example, is not assigned to duty requiring him to treat venereal diseases, nor is a man experienced in ear, nose and throat practice assigned to treat fractures or to do abdominal surgery.

It may be easily imagined that the results of this arrangement have proved eminently satisfactory and advantageous to the soldier-patient as well as to the medical officer. Indeed, it marks a signal advance in the administration of military medical affairs.

Hospital Division.—In addition to this epochmaking expansion of the medical service along the lines of specialization, the Surgeon General's Office has expanded in many other directions. The Hospital Division, for example, organized in May, 1917, for the purpose of the construction, organization and supervision of military hospitals of all kinds, of hospital trains and ships, of sanitary trains, sanitary squads for lines of communication, convalescent camps and depots, and reconstruction hospitals, schools and workshops, has accomplished its manifold

purposes so admirably that we now have in this country well-equipped base hospitals in which facilities are at hand for the operative or other treatment of the most complicated cases in a manner not be surpassed by the best civil hospital; convalescent hospitals and camps for the after-care of the sick and wounded; and curative workshops and schools for the rehabilitation and reëducation of all who may need to be made over, so to speak, and made ready to reënter civil life as self respecting members of society. In December, 1917, they had established eighteen 1,000-bed hospitals; six 600-bed hospitals, and nine 500-bed hospitals, and others under constructions. In addition, numerous hotels, army posts, health resorts, private estates, large commercial establishments and other institutions have been converted to hospital purposes. The organization and dispatch abroad of numerous Red Cross and Army Base hospitals, the organization and training in this country of personnel for evacuation hospitals, hospital trains and evacuation ambulance companies are to be numbered among the activities of this division.

The number of beds in army posts at the beginning of the war was 6,544. The number of beds in the service of the Army in the United States at present is 79,077.

The overseas manifestation, however, of the remarkable expansion which the Surgeon General's Office has undergone, as seen in the immediate care, at the front, of the sick and wounded, the marvellous facilities for rapid evacuation and transportation, and the general efficiency of the nursing service, will not be thoroughly realized until the war is over and the Division of the Medical and Surgical History of our part of the war has been completed

On November 15, 1918, there were 236,000 hospital beds available in France for the American Expeditionary Forces, and 121,883 hospital beds available in United States Army hospitals in the United States, making a total of 357,883. On the date above mentioned, November 13, 1918, there were

193,448 patients in the A. E. F. hospitals in France and of these, some 99,000 were injuries; there were 70,000 in our base hospital in the United States of the same date.

Laboratory.—The work in the Laboratory Division is quite interesting. It was organized as a separate division May 8, 1917. The function of this division is to supply our army hospitals with facilities for doing laboratory work for the treatment of acute infectious diseases and diseases of metabolism, with an accuracy comparable with that possessed by the best hospitals in the United States.

This has functioned up to date, so as to carry out the most ideal expectations of its projectors.

Through the number of its experimental workers, it has obtained many new ideas, and a great many promising leads, some of which have already, and others promise to be of great advantage in bacteriological science.

This department also furnishes the vaccines for the entire Army, Navy and National Guard. It also has furnished vaccines for the contractors, to be used upon the men in connection with army work. All these vaccines are produced at the Army Medical School.

Along educational lines it has obtained schools for physicians and technicians, both male and female, in bacteriology, pathology, pathological histology, and epidemiology.

Vaccines have been produced for paratyphoid in addition to typhoid, and encouraging results have been obtained in vaccines for pneumonia, and meningitis.

The personnel of the average army laboratory consists of five officers and twelve enlisted men. Overseas hospitals are equipped with personnel in the same way.

The Laboratory Division also does work in the Army cantonments, which have a citizenship of 20,000 to 40,000 people. It is necessary for the Laboratory Division to do the work in connection with the public health. Therefore, this division in connection with its military laboratory work also performs the

laboratory work carried out by Boards of Health in our municipal government.

All this work is done in the laboratories in the base hospitals of these cantonments.

Finance and Supply.—The organization of a personnel for the Finance and Supply Division of this department was commenced July 21, 1917. This was necessary in order to find the experienced help required to purchase, inspect, supervise transportation, issue and account for the drugs, appliances, instruments, dressings, antiseptics and the thousand odds and ends necessary for the sick and wounded of an army of over a million.

The first consideration was to find suitable material for officers, time not permitting of any preliminary training. These men when found, had to be examined, commissioned and assigned to the various scenes of their future activities as quickly as possible. There were no store or warehouses at the different camp or cantonment locations, and the medical and surgical supplies, as fast as they arrived, had to be stored under canvas or in outbuildings on the farms which were being turned into camps and cantonments. Each medical supply officer had to adapt himself to local conditions, and his hours of duty were the whole twenty-four, as often he had no assistance. As the troops began to arrive, enlisted men were detailed to duty in the improvised depots, and conditions improved, and soon afterwards buildings were constructed for storehouses, and the Camp Medical Supply Depot was launched.

To date there have been commissioned in the Sanitary Corps, for service in the Finance and Supply Division, three hundred and sixteen officers; this in addition to sixteen officers of the Medical Corps engaged in this work. The rank of the officers in the Medical Corps from Major to Colonel, and the Sanitary Corps, from second lieutenant to Major. Fourteen hundred and seventy-one enlisted men are engaged in supply depots in the United States and abroad, and four hundred and twenty-five men in special units, such as the Surgical Instrument Repair

Unit in France, consisting of eighty-nine enlisted men and one officer, equipped with all the machinery and material necessary to repair, and make, if necessary any and all of the instruments in use.

The motor Ambulance Assembly Unit was composed of three officers and sixty-eight enlisted men, who had been gathered from all of the important automobile plants in the United States. This was followed by the Accounting and Auditing Unit of the Medical Department, which had six officers and one hundred and thirty-five enlisted men, and to which has been entrusted the finance and property accountability of the Medical Department overseas. Then came the optical shop, with two officers and twenty-five enlisted men, and lesser units making a total as above.

The principal depots of the Medical Department were in New York City, Philadelphia, Washington, Atlanta, Chicago, St. Louis, San Antonio, San Francisco, Honolulu, Hawaii, Manila, P. I., and France and England. The principal purchasing being done in Washington, D. C., under the officer in charge of General Purchasing, Medical Department, and lesser purchases are made at three of the other depots. There are eight of the large issue depots in the United States, one motor ambulance assembly depot; two embarkation depots, two piers, together with thirty-six camp and cantonment depots.

In all this work the greatest care has been taken to eliminate the unfit, and only the best have been selected to face the hardships and vicissitudes of the life overseas. Many of these officers are now issuing supplies in the rear of the firing line in France.

Today training schools have been established and every effort is made to see that each officer, non-commissioned officer, and private is fully qualified before he is assigned to duty. Of the three hundred and sixteen officers of the Sanitary Corps now engaged in supply work, two hundred and seventy-three have been promoted through the various grades of private, non-commissioned officer and officer.

DISCUSSION.

Dr. John D. Thomas: I can verify at least partially, from the other end of the line—in France—the enormous amount of material of all varieties necessary and the degree of energy that must have been expended in furnishing them. Our hospital was a 3000-bed one, situated in the district of Paris—Base Hospital 41. When we arrived in July, 1918, the Red Cross took charge of outfitting us, as I understand the army just at that time could not do so. The Red Cross was not so restricted by regulations and rules and could go into the open markets of Paris or elsewhere and get material of any kind which might be needed at once. But later on we were taken over by the Army. And stores of all kinds and descriptions were handled in immense quantities. While there may have been, and in fact were, some instances where conditions might have been bettered—when the proposition is taken as a whole in its immensity and detail, with final results to judge by, the work was a prodigious and successful one.

Lieut. Col. Charles W. Richardson: Of course you all know during the acivities of moving the troops with supplies of all kinds, were simplified and at that time there was an enormous amount of supplies at the embarkation on the other side, but could not be transferred.

The coöperation between the Red Cross and the Army was absolutely perfect. The Red Cross at this period had an enormous amount of supplies on hand.

MEDICAL WORK IN THE BRITISH ARMIES IN FRANCE.*

By GEORGE CHEEVER SHATTUCK, M.D.

Organization.

It will be of interest, I think, to consider the important types of hospitals which were used by the British in France, and to outline the plan for handling patients.

The hospitals in question were of three principal classes, namely: the "Field Ambulance," the "Casualty Clearing Station" and the "General Hospital."

The Field Ambulance.—A field ambulance was attached to every fighting division in the field. When the division went into the line the field ambulance established itself within reach, and when the division was withdrawn for rest, its field ambulance retired with it. The functions of the ambulance were to collect the wounded from the regimental aid posts and when necessary from the field, to put on dressings and splints, stop hemorrhage, and evacuate the cases with the least possible delay to the casualty clearing stations in the rear, where most of the operating was done. The wounded were collected by stretcher-bearers and evacuated by ambulance cars. When "in rest" or when there was no fighting these units treated the milder cases of sickness which could be cured and returned to duty in a short time.

A hospital of this kind is of necessity small, and capable of moving all its equipment in a few hours. It needs few surgeons, but requires a relatively large number of stretcher-bearers.

The Casualty Clearing Station.—Next we have the casualty clearing station or "C.C.S." at railhead, receiving cases from the

* Service at 22 General Hospital, British Expeditionary Forces as a member of the "Harvard Unit" in 1916, 1917 and 1918 and detached duty with Casualty Clearing Stations in 1917 and 1918.

field ambulances. A clearing station can ordinarily accommodate five hundred cases and has facilities for expansion to 1,000. Every army at the front had a number of these units belonging to it. They moved with it when necessary, but moves were not frequent during the period of trench warfare.

The "C.C.S's" were generally grouped in the neighborhood of a town, but not in it, because towns were much more subject to air raids and shelling than was the surrounding country. Consequently permanent buildings were seldom available.

The "C.C.S." was intended originally to be an essentially mobile unit, but in the long period of trench warfare the necessity of early operating to prevent infection led to increased development which resulted in diminished mobility. Much of the canvas was replaced by wooden huts, bacteriological laboratories and radiologists became attached, nurses appeared in the wards, and nurses trained in anesthetics released officers for other work. For a long time the physician as such had no recognized place in a "C.C.S.," but in the Second Army at least, physicians were later appointed for all of these units.

General Hospitals.—The large hospitals to which the clearing stations evacuated their sick and wounded were called "general hospitals." These were on the coast, some in towns where they occupied permanent buildings, and others in open country where huts and tents were erected for their use. Patients came to them by ambulance car from the hospital train. The principal avenues for evacuation were the "convalescent camps" in France and the "hospital ships" for England.

The capacity of most of the "general hospitals" was increased several times during the war and finally reached 2,400 comprising about 1,400 permanent beds and roughly 1,000 stretchers or bed sacks.

Work of a General Hospital.

Number Twenty-two General Hospital at which the Harvard Unit served, and to which I belonged, was provided by the unit with physicians, surgeons and nurses from America. All the

administrative officers were British until Lt.-Col. Cabot took over the command. The non-commissioned staff and the men remained British. Like other "general hospitals" it had two divisions, a surgical and medical, between which ward accommodation was shared in fluctuating proportion according to need.

The "establishment" of a general hospital included thirty-two officers. The duties of three of them were purely administrative, viz: the officer commanding, the registrar and the quartermaster. The chiefs of the medical and surgical divisions were responsible in a general way for the management of their divisions, and took part in clinical work as well. The rest of the clinical work was done by officers assigned to one division or the other, each officer taking charge of a number of wards. There was an officer in charge of the clinical laboratory and another of the x-ray department.

The number of beds that a physician could look after depended partly on the type of cases he received and the rate at which they were being admitted, but even more on his experience. If he could not keep ahead of the work, evacuations were delayed and beds which should have been vacant remained occupied. Moreover, in busy times the absolutely necessary work increased out of proportion to the admissions because prompt evacuation became imperative. At such times the man of experience could do more than two not familiar with work of this kind.

Two wards of 60 beds each with from 10 to 20 new patients a day was found to be more than a new man could handle efficiently. He could examine and treat them, but could not dispose of them promptly, whereas the same man a few months later could learn to handle twice that number of stretcher cases or a much larger number of walking cases.

In 1917 and 1918 the number of officers on duty at 22 General was at all times below the authorized establishment, and generally far below it, all available officers having been detached for temporary duty with hospitals even more depleted than our own.

More and more medical officers had to be sent from the bases to fill vacancies in the forward areas so that, in the last year of the war, shortage of medical officers at the general hospitals became acute. During this period with a staff smaller than at any previous time our hospital did its largest amount of work.

The principal factors making for efficiency were, I believe, the following: firstly, the officers had learned every detail of their work; secondly, ward routine and laboratory work were systematically reduced to lowest terms; thirdly, the nurses learned to be very helpful; and lastly, the British officers and personnel coöperated with fine spirit.

The Medical Division.

A rough idea of the work of the medical division can be gained from the accompanying Table I, showing numbers of patients admitted to the division and their disposal during the month of February, 1918. At that season of the year the medical division handled only medical cases in the civil sense.

"Paper work" was, I believe, simpler than in the American Army but, nevertheless, took a considerable proportion of time when patients were passing through the hospital in large numbers. Many of the forms were prepared by clerks in the divisional offices and from there distributed to the wards for completion. Volunteer clerks from among the convalescents were invaluable in the wards for walking cases. With their help a medical officer could look after a much larger number of patients. In the other wards the nurses and their aids helped also in this work. No patient could be evacuated until the required papers had been completed and signed by the officer in charge of the ward.

To sift and rapidly to dispose of patients was the prime necessity of busy times, and medication became largely a matter of routine.

When there was pressure for beds patients were evacuated as soon as fit to travel and in these circumstances a large proportion went to England, but in quiet times when they could re-

main a week or two in the hospital the great majority of sick were evacuated to convalescent camp, from which they passed when fit for duty to the "base depot."

A few, who recovered while with us, went directly to "base depot" for duty, and the partially disabled or permanently unfit were boarded there for reclassification or discharge from the army.

Contagious diseases were isolated and promptly transferred by ambulance to a hospital designated for their care. Similar special assignments were made for enteric, dysentery, so-called "shell-shock," mental disease, and venereal disease. Special labels were required for cases of organic and others for functional nervous diseases destined for England, so that the patients would be sent directly to certain hospitals there. Diagram I shows the main lines of evacuation and some of the subsidiary circuits.

The patients arrived in convoys of from fifty to five hundred at a time, and rarely eight hundred or more were admitted in a single day. They had to be fed, washed, clothed when necessary, classified, catalogued, and redistributed through many channels.

Two military aims were never lost sight of: firstly, to have at all times enough vacant beds to accommodate a convoy; secondly, to hold in France for return to duty every man who would be fit for it within the time during which he could be kept in hospital or at convalescent camp. The first of these needs took precedence over the second, and the interest of the individual yielded to both.

It is here that military medicine most sharply differs from civil practice. War requires sacrifice of the individual whenever such sacrifice may contribute to success, or to the interest of greater numbers, and this is the lesson which we found the hardest to learn. When patients stayed in the hospital long enough to become known as individuals it was hard to deny them the chance of going to England to convalesce, the more so because home-leave for the private soldier could only be provided at

long intervals. To write "C.C." or "B.D." on the card of a man who had been long from home, and who would soon again return to the trenches, seemed like imposing sentence upon him because he had had not the good fortune to be seriously ill or to receive a severe wound. After the first two years of war "Blighty" seemed Heaven to the men, and a severe wound a small price for the privilege of going there. One fellow, typical of many, with a ragged wound which laid open the deltoid of his right arm, told me with delight that the doctor "up the line" has said it was "a sure Blighty" and had added that he would give five pounds for one like it.

When convoys were being admitted the strictly medical cases were assigned to wards reserved for their care. When the surgical division became crowded, border-line cases, such as trench feet, went to the medical wards, and vice versa. When a battle was expected the medical cases remaining in hospital would be concentrated in a few wards, and half, or even more, of the medical division equipped to handle wounded. The physicians remained in charge of their wards at such times, for the surgeons had enough to do looking after their own wards and doing the operating. The physicians selected and sent promptly to the theatre, cases urgently requiring operation. Doubtful cases were seen by a surgeon.

When, during the summer of 1916, a large number of cases of chest-wound were admitted, and the physicians were consulted about them, it was soon found that a considerable proportion of these cases did well without operation, and that others required study for which the surgeon had no time. Chest-wounds in our hospital were thereafter admitted direct to one of the medical wards. The same practice was followed at other general hospitals.

Diagnosis.

The field ambulances made abundant use of conventional terms in lieu of diagnoses. For example, "P.U.O.," meaning "pyrexia of unknown origin," stood for various kinds of fever;

"N.Y.D." for "not yet diagnosed"; "Myalgia" indicated pain without obvious case; "V.D.H.," valvular disease of any kind; "D.A.H.," "disordered action of the heart" without gross lesion, and "I.C.T." or "inflammation of connective tissue" included a wide range of minor inflammatory processes.

This system enabled the field ambulance rapidly to pass along minor ailments without delay. The casualty clearing stations and other hospitals farther down were ordered to replace the conventional letters by diagnoses of a definite character.

Cases of serious illness were definitely diagnosed "up the Line" and were held as long as necessary at the "C.C.S."

The Casualty Clearing Station or "C.C.S."

The "C.C.S." was generally one of several which received in turn for twenty-four hours consecutively on every second or third day during quiet or "peace times" as they were called. At such times most of the patients were "sick" so that many could be returned to duty within a week.

When fighting was heavy the system changed to one in which cases were received until 200, or some other number previously agreed upon, had been counted. Subsequent arrivals were then directed to the "C.C.S." which had taken over the admitting until they had received their quota and so on in turn. For making up the quota, the stretcher case was the unit and was counted as one, but the walking cases counted only half as much. For example, the quota of 200 might be made up of 100 stretcher cases and 200 walking cases or of 150 stretcher cases and 100 walkers.

The walking wounded were redressed and nearly all marked for evacuation at the earliest opportunity. The stretcher cases were examined and classified. Those fit to travel and not urgently in need of operation were sent to the evacuation wards. Patients in bad condition were put in the resuscitation ward, where an officer skilled in transfusion of blood took charge of them. Wounds of the chest were sent to the chest ward, gassed patients to their special wards and the sick to theirs.

Cases urgently in need of operation, whether officers or men, went to the preoperation ward, those needing x-ray having been so marked. There, lying on the stretcher often in their muddy, blood-stained uniforms, they awaited their turn.

In this ward one saw most clearly the calm, patient courage of the British "Tommy." He rarely asked for anything unless for water. He never enquired the nature of his wound, his chance of recovery or what would be done. When carried into the theatre his face showed relief, but no anxiety. If a leg needed amputation he assented without demur or emotion. His thoughts were at home in "Blighty" and he expected to get there.

Amid such surroundings one might ask, What can a physician do? The question was answered by experience. At first there were no physicians recognized as such at the clearing stations. They were acting as anesthetists. This arrangement was not ideal, because even when there was fighting, varying numbers of seriously sick were received and gassed cases were sometimes very numerous. These two groups of cases could not be satisfactorily dealt with by a man whose first duty was to give anesthetics, and moreover the shortage of medical officers became steadily more serious.

In the last year of the war nurses were giving the anesthetics, and physicians had been appointed to take charge not only of the sick and gassed cases, but also of the chest-wounds in the clearing stations of the Second Army (Table II). Other physicians had been trained as radiologists, some were taking the place of surgeons by rendering efficient service in the receiving ward, and others were taking charge of resuscitation and doing blood-transfusion.

When the influenza epidemic was at its height the battle casualties were light in many parts of the line, but the medical work was so heavy that the surgeons, at times, took part in it. These conditions were exceptional and transitory, but the plan of having a skilled physician on the staff of the clearing station worked well under conditions of all sorts. When, as was oc-

casionally possible, a second physician could be found to take charge of the resuscitation ward or to help with the medical work, it was a great advantage.

Diseases.

The commonest febrile disease in 1916 and 1917 was trench fever, but in 1918 influenza was epidemic and trench fever less frequent than before. The first cases of influenza that I saw in the spring of 1918 were very mild and returned to duty after a few days. In July the disease became more severe, bronchitis was often observed, and, occasionally, bronchopneumonia but I saw no deaths until the autumn when bronchopneumonia became, not only common, but severe, and the death-rate high.

There was dysentary of the Shiga type in Belgium in 1917 but in 1918 that of Flexner predominated. In both years there was a good deal of afebrile "dysentery" of short duration, the stools showing blood and mucus for a few days, and then returning rapidly to normal. Repeated bacteriological examinations having failed to show any more likely organism, the enterococcus was suspected.

Between August and October of 1917 near Popernighe in Belgium I saw a good many cases of gastro-enteritis. The first cases complained chiefly of vomiting, and a few seemed dangerously ill but all recovered. They had little or no diarrhœa. The type then changed to one in which abdominal pain predominated and there was occasionally vomiting or diarrhœa. About a dozen of these patients which arrived about the same time had on the "field ambulance cards" the diagnosis "query appendicitis." In subsequent cases diarrhœa with dysenteric stools became the rule. Most of the patients were afebrile and had negative stool-cultures, but among them were a few with fever and in most of these the Shiga bacillus was found.

Typhoid fever in my experience was extremely rare. I saw but one typical case in more than two years of work and the patient recovered after running the usual course of fever. Para-

typhoid was not rare, but we saw surprisingly little of it. Again and again patients who were having a run of fever suggesting mild typhoid were examined bacteriologically with negative results and sent, nevertheless, to the isolation hospital as typhoid suspects. Nearly always the diagnosis returned by the isolation hospital was trench fever. In the few exceptions it was paratyphoid.

The atropine test of Marris was tried on a large series of cases including many controls and discarded as misleading and practically valueless. The Widal in men who have been inoculated is little better. The Dreyer method, I believe, has some value provided the suspect can be isolated during the period of a week or more during which the series of agglutination tests is being made, but, when the question was whether or not to transfer at once to a special hospital as a typhoid suspect, it was necessary to use quicker methods. Blood and stool cultures answered best, and agglutination in usuaually high dilution was regarded as sufficient evidence for isolation.

Contagious diseases were few, both at the clearing stations and at the base. Suspicious throats were always cultured but generally proved not to be diphtheria but Vincent's angina, of which there was a good deal.

Few cases of meningitis were seen. One young fellow with slight fever had symptoms of hysterical origin simulating meningitis. Later it was learned that he had had meningitis five years before.

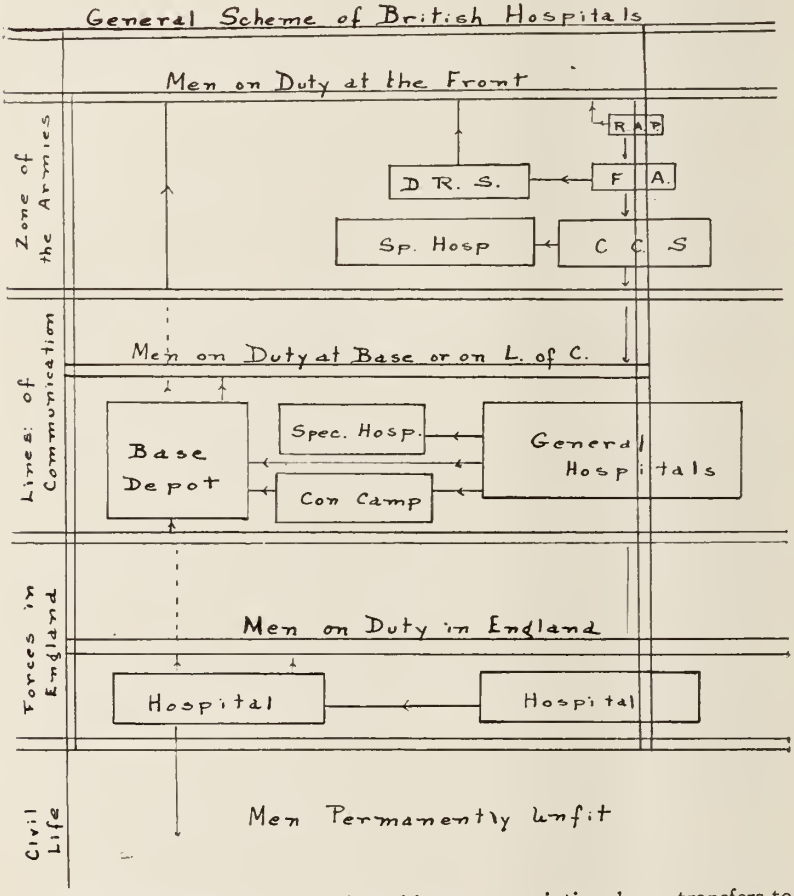
There was a small but interesting group of cases of infectious polyneuritis. Later cases, very similar, showed evidence of lesions of the cord.

Most of the "myalgias" seemed to be trench fever with leg pains, in an afebrile period. There was also a noteworthy number of cases of sciatica often traceable to the sacro-iliac joint. Rheumatic fever was astonishingly rare. A few cases only were seen and these were subacute.

The "trench nephritis" was interesting in that dyspnœa

when marching with equipment was often the first symptom noted by the patient. It was soon followed by swelling of the legs. The symptoms often increased gradually for a week or two before the man reported to the doctor. Whether or not infection plays a part in the etiology, seasonal fluctuation was

Diagram I



The line of evacuation is indicated by arrows pointing down, transfers to subsidiary hospitals by arrows pointing to the left, and return to duty by arrows pointing upward.

observed in three successive years. Nephritis was common in the spring. When warm summer weather had become established, typical cases became scarce. They reappeared in the autumn and early winter after a month or two of cold and wet. This experience points to exposure as an important factor in the production of most cases of war nephritis. Death from nephritis was rare.

To discuss the injuries from gas, the functional nervous disorders, and the chest-wounds would exceed the scope of this paper.

I wish at this time to express gratitude to Lt.-Col. Cabot under whom I served and to others who helped or encouraged my work.

TABLE I.

MEDICAL DIVISION.
Month of February, 1918.

Remaining from Last Month.	Admissions, February.	Died.	To England, Per Cent.	C. C.,* Per Cent.	B. D.,† Per Cent.	Transferred.	Remaining in Hospital.
988	1591	1	470 18.1	977 41.4	246 9.5	91	794

TABLE II.

ANALYSIS OF CHEST WORK OF A "C.C.S." IN THE AUTUMN OF 1917, NEAR POPERNIGHE.

Dates.—September 23 to 29, 1917, inclusive.

Operated Cases.	Evacuated to Base.	Died at C. C. S.
1. Parietal wounds only	5	0
2. Open pneumothorax	2	2
3. "Uninfected" hemothorax	5	0
4. Foreign body removed from pleura	1	0
5. Established infection	3	1
	16 or 84.2 per cent.	3 or 15.7 per cent.
Cases not operated on	46	5
	Total 62 or 88.5 per cent.	Total 8 or 11.4 per cent.

Grand total for week.....70 cases.

* "Convalescent camp."

† "Base depot" for return to duty.

INTERNAL MEDICINE AS OBSERVED AT A BASE HOSPITAL IN FRANCE.

By GEORGE MORRIS PIERSOL, M.D.,

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The accomplishments of the surgeons in the recent war have attracted more attention and have received greater publicity than the less spectacular but no less important work of their medical colleagues. The rôle of the surgeon is undeniably more dramatic than that of the internist, and the medical, as well as the lay mind, is strongly inclined to regard wounds and battle casualties as the chief sources of diasbility in an army. The facts, however, fail to bear out this popular belief. Statistics show that in all great wars—and the recent war was no exception—more men are disabled as the result of *medical* conditions than surgical, and that disease is a more potent factor in the production of casualties than shell and rifle fire.

The medical experiences of officers in France differed greatly and varied within wide limits according to the type of work they were called upon to perform. As a consequence many diverse opinions are heard. Those officers who duties kept them chiefly in the zone of the advance, saw, as a rule, far more of surgery than of medicine. It fell to their lot to care for and observe an enormous number of serious surgical cases, whereas they had comparatively little to do with those suffering from medical conditions. The medical cases, for the most part, were transportable and, therefore, very properly were rapidly evacuated to the rear. Hence, it is safe to say, that the best place to obtain an accurate idea of the scope and importance of internal medicine in the A.E.F. was at a base hospital; particularly at a base hospital located in a rear area, since the more serious

medical cases were usually sent to one of these organizations. Here they were allowed to remain a sufficiently long time for careful diagnosis and treatment.

The object of this communication is to discuss the character of medical work as it was found in one of the many regulation 2,500 bed base hospitals that dotted central France. The data utilized for this report have been taken from the records of U. S. Army Base Hospital No. 20, and cover the period of that organization's active operations in France.

To this hospital a total of 8,706 patients was admitted. Of these 3,775 were surgical cases and 3,752 were credited to the medical section, leaving 1,179 to be divided among such special services as the genito-urinary, eye, nose and throat, etc. These figures, which do not differ essentially from those obtainable from the records of many of our overseas base hospitals, indicate the numerical equality that existed between the surgical and medical services.

There were certain striking differences between the medical work seen in the hospitals of the A.E.F. and that encountered in civilian practice. In civil life the internist is called upon to manage disease in all types, classes and ages of people, whereas in the military hospitals of France, his patients were all drawn from a selected group of able-bodied, reasonably healthy, young, adult males, engaged in an exceedingly hazardous occupation, and who at the same time were being subjected to unusual degrees of exposure and fatigue, in conjunction with bad living conditions and frequently a poorly prepared and monotonous diet. The result was that medical patients in the military hospitals were for the most part suffering from acute conditions, such as acute infections, fatigue phenomena, and acute gastro-intestinal disturbances; in contradistinction to the varied array of chronic visceral disorders, the result of congenital defects and various degenerative processes, which constitute such a large proportion of the conditions observed in the average civilian medical practice. Of the medical cases

treated in Base Hospital No. 20, 3,461, out of a total of 3,753, were suffering from acute disturbances, the direct result of battle, exposure, fatigue, infection or dietetic errors.

The medical cases met with in a base hospital can be divided into two main classes. Class I includes those cases whose condition was directly the result of the activities of warfare. Class II embraces those who were suffering from diseases not peculiar to war, but which might overtake an individual at any time.

The most conspicuous and by far the largest group of cases that came under Class I, were suffering from the effects of various deleterious poisonous gases. 1,415 such cases were admitted to Base Hospital No. 20. This number included those who were affected by suffocative gases, such as chlorine, phosgyne ($COCO_2$) and diposyene, and vesicant gases, of which the dichlorethylsulphide ($C_2H_2Cl_2S$), so-called mustard gas or Yperite, was the commonest variety. It is impossible to state the exact number of patients that were affected by each type of gas. It is true, however, that the vast majority were suffering from the effects of mustard gas. It is an interesting fact that although in the early part of the summer of 1918 a number of cases were admitted that had been gassed by phosgene, these cases became rarer during the latter part of the war, so that from the middle of August on, practically all gassed cases were suffering from the effects of mustard gas. Whether this was a mere accident, or whether other hospitals had the same experience, is not known. It has been suggested, however, upon reasonably good authority, that the few cases of phosgene gas poisoning seen during the latter part of the hostilities, was due to the fact that the enemy had exhausted certain materials necessary for the manufacture of this deadly gas and had to fall back upon the no less effective, though perhaps less fatal, mustard.

In our experience, comparatively few of the gassed cases proved fatal, although many were seriously ill. This is not surprising in view of the fact that during the acute stages, cases of gas poisoning were *not* transportable. For this reason no acute

cases of phosgene poisoning came under our observation. We were spared the painful sight of restless, anxious, partially asphyxiated, prostrated men suffering from air hunger and acute pulmonary edema, so common in the field and gas hospitals at the front. The phosgene cases which were observed were either slightly gassed or were men who had recovered from the acute manifestations and were suffering from the late results, such as bronchitis or some of the various systemic changes.

Since the early symptoms of mustard gas poisoning were frequently not severe and since the more disabling manifestations were often delayed in their appearance, a better opportunity was afforded for observing many cases seriously ill from this type of gas poisoning than from any other. The mustard cases were almost invariably suffering from external burns. Sometimes these were widespread, but for the most part they were limited to the genitalia, the buttocks and the parts of the body that were particularly moist from sweat. In many instances these burns were deep and severe, slow to heal and decidedly disabling. In addition to these external manifestations, most of the mustard gas cases suffered from inflammations of the various mucous membranes. Conjunctivitis was frequent. Inflammatory conditions of the respiratory tract, varying from a slight laryngitis to a severe and widespread bronchopneumonia, were exceedingly common, and a certain proportion of cases also had gastro-intestinal symptoms, notably epigastric pain, intractable vomiting and often persistent diarrhœa. Of the total, 1,415 patients suffering from gas in one form or another, 1,375 were returned to duty; 37 were transferred to the rear or were returned to the United States as no longer fit for duty at the front, and only 3 died. This low mortality is in itself conclusive evidence that the type of gassed patients received was not the serious form found nearer the front.

Another group of cases that may be properly classed as battle casualties, were those suffering from psychoneuroses and exhaustion. Our experience was rather limited with this form of

disease, since only 90 patients were admitted that could be included in this category. The majority of these cases were admitted early in the summer of 1918. After August few cases of this type ever reached the rear areas. This was directly traceable to the work of the neurologists, so well organized by Colonel Salmon. It will be recalled that the neurological staff, with representatives stationed at the front, weeded out all the functional nervous cases at the "triages," so that from the first they came under the control of trained neurologists. This method of procedure succeeded so admirably, that during the latter part of the war, only about 14 out of every hundred nervous cases seen at sorting stations, were ever evacuated to the hospitals in the rear. Of the few functional nervous cases that we did handle, 83 were returned to duty, and only 7 had to be transferred to neurological hospitals or returned to the United States.

The so-called cases of "D.A.H.," or better, effort syndrome, can also be placed in Class I. Only 54 cases were admitted that could be definitely regarded as cases of effort syndrome per se. However, a considerable number of cases that closely resembled effort syndrome for all practical purposes, were observed among the convalescent gassed patients. The only interesting fact to be noted in reference to these cases of effort syndrome, is their management. Following the experience of the English, all cases of effort syndrome, as well as the convalescent gassed patients that exhibited similar cardiovascular and nervous symptoms, were treated by graduated exercises. The method followed was much the same as that so successfully carried out at Hamstead, England. Men were formed into groups and given gradually increasing exercises and marches according to their endurance. As a man improved he was graduated from one group to another, until finally he was able to take the most advanced set of exercises and to "hike" in formation for a considerable distance without any recurrence of his symptoms. These exercises and practice marches were under the charge of non-commissioned officers and were supervised by medical

officers assigned particularly for this work. The results were so gratifying in cases of effort syndrome and convalescent gassed cases, that finally the system was enlarged so that it included all convalescent cases who were able to exercise. This procedure made it possible not only to bring soldiers back under military discipline sooner, but also to materially lessen their stay in hospital. It was estimated that on an average those who were given graduated exercises during convalescence, were returned to duty from ten days to two weeks earlier than those patients who were allowed to convalesce more leisurely.

Trench fever and trench nephritis are two other conditions that may be regarded as the direct result of war activities. As in most American hospitals, so in Base Hospital No. 20, trench fever was a rarity, only five cases of this infection were observed. The freedom of the American Army from trench fever is worthy of note. There is no question from the recent work that has been done, that trench fever is a clinical entity, and that the infection is louseborne. In the British and French armies, trench fever proved a serious cause of disability. The comparative freedom of the American troops from this infection has been observed by R. Fitz in an interesting comparative study on the medical casualties in British and American troops. From his statistics, in a group of British soldiers about 31 per cent. of the medical casualties were due to trench fever, while in a similar group only 9 per cent. of American casualties were due to this disease. His explanation of this discrepancy is probably the correct one. He suggests that it is because the Americans were billeted in areas where infected lice were found in small numbers and where the number of trench fever carriers was so small as to prevent a general infection of the lice. The fact that our troops were never subjected to the long continuous periods of trench warfare in infected trenches, as was the case among the British troops in northern France and Belgium also helped to lessen the occurrence of this disease.

Whether or not trench nephritis is a new clinical entity is

still a matter for discussion. In Base Hospital No. 20, only 23 cases were admitted suffering primarily from nephritis. Most of these cases were chronic, or at best of the subacute type of nephritis. A very few could be regarded as truly cases of acute Bright's disease. The acute and subacute cases in almost every instance, followed some definite etiologic factor, such as a recognized acute infection. They differed in no way from nephritis as ordinarily observed and could not be regarded as instances of trench nephritis.

Among the cases included in Class II, that is, those suffering from diseases that were not peculiar to war, by far the largest number suffered from influenza, epidemics of which occurred in various parts of France last autumn just as they occurred in the United States. Affections of the upper respiratory tract came next. Acute conditions of the gastro-intestinal tract made up the next largest group, while tuberculosis, acute articular rheumatism and pneumonia of various types were also of fairly common occurrance.

Happily, in Base Hospital No. 20 influenza never attained serious proportions, only 598 cases of this infection were observed. These cases were for the most part mild in type, and were not comparable to the severe form of infection that occurred in this country or in some other parts of France. That the disease never attacked the personnel of the hospital to any great extent and never spread from one part of the hospital to another is doubtless largely due to good fortune, but it is believed that in part at least, this control of the disease was due to the early and careful precautions that were taken.

All cases of influenza that were admitted, or that developed within the hospital, were immediately isolated in wards set aside for that purpose. Every case was separated from his neighbor by careful cubicilization. Doctors, nurses and all attendants were required to wear caps, gowns and masks whenever they entered the wards in which influenza cases were being treated. After leaving the wards, and before entering any other place

where there were patients, it was made obligatory upon them to thoroughly wash and disinfect their hands. Another factor undoubtedly aided greatly in preventing the spread of the disease, namely, that the medical cases were housed in former hotel buildings, so that instead of having a large number of patients in a single ward, the patients were divided into small groups quartered in separate rooms. These rooms were kept warm but well ventilated, and the patients were given an adequate amount of night clothing and bed covers. In any event, the mortality of this infection was astonishingly low. Only two cases died of this disease, and two more died of a bronchopneumonia which was probably secondary to influenza.

Infections of the upper respiratory tract, including tonsillitis, laryngitis and bronchitis, exclusive of patients who developed such inflammatory conditions secondary to gas poisoning, embraced 419 cases.

Pneumonia, both lobar and bronchial, occurred infrequently, only 17 cases of lobal pneumonia and 42 of bronchopneumonia were observed. Out of this total of 59 cases only 7 deaths occurred. This gratifyingly low mortality could not be attributed to any specific or unusual form of management. All the pneumonia cases were segregated and isolated similar to the way in which the influenza cases were handled. Those in attendance upon them were compelled to adopt the same precautions that were enforced in the influenza wards. Crossed infection was prevented by careful cubicilization and the patients were managed by the well known combination of fresh air, active elimination and early stimulation. As a routine measure, all pneumonias received full doses of digitalis early in the disease.

As might be expected, acute gastro-intestinal conditions played a conspicuous part in the medical service; 363 cases of acute entero-colitis were observed. None of these cases proved to be very serious or disabling, and 306 were ultimately returned to duty. In addition to the acute entero-colitis, there were 33 cases of dysentery, proved bacteriologically.

It is interesting to recall that the vast majority of these cases of acute enteritis and dysentery were admitted during the latter part of July and the early part of August. At this time most of the American Army was fighting above Chateau Thierry, around Soissons and the Vesle, and most of the cases admitted came from this region. It is a matter of record that the battle-fields in this sector were badly policed: the country was strewn with feces; and dead animals and men in various states of decomposition abounded. Flies became a veritable pest. The weather was hot, water was hard to obtain, and many of the supplies that were available were infected. The result was, as is well known, a widespread epidemic of serious acute diarrhœal diseases. The diarrhœa was not due to any one particular organism, but to many. Typhoid and paratyphoid bacilli, and various organisms of dysentery, were all discovered by the bacteriological survey made at that time. The condition was looked upon as a serious one, and it is no exaggeration to say that had it not been for the thorough and widespread immunization of our troops against typhoid and paratyphoid fever a disastrous epidemic would have marred that brilliant military achievement.

The cases of dysentery that came under our observation were bacillary in type and the bacillus of Shiga, Flexner's bacillus and the Y bacillus were the organisms isolated. In order to prevent the spread of these diarrheal diseases, the cases were segregated as far as possible, and their stools were carefully studied bacteriologically so as to avoid the error, probably all too frequent, of not recognizing in presumably harmless diarrhœas mild types of dysentery.

Rheumatic fever was observed with fair frequency. In all 172 cases of this disease were admitted. Most of the cases were not of a severe type, but in a few of instances a complicating acute endocarditis or pericarditis developed.

Recent reports would indicate that a considerable amount of typhoid fever and paratyphoid fever has been observed among the

American Expeditionary Forces. During the active period of Base Hospital No. 20, only five cases of typhoid and two of paratyphoid fever were observed. The diagnoses were proved bacteriologically, and in one case of typhoid fever with severe hemorrhage and multiple perforations, by autopsy. Among the 17 cases recorded as fever of undetermined origin, there were a number that were doubtless cases of paratyphoid fever, but in whom this diagnosis could not be established for lack of bacteriological confirmation.

Perhaps the most interesting medical work that was done in Base Hospital No. 20, was that on tuberculosis. This hospital was designated as one of the three centres for the observation of suspected cases of tuberculosis. The result was that a large number of cases were admitted with this diagnosis tentatively made. The establishment of centers for the observation of suspected cases of tuberculosis was found necessary because of the large number of men who were being returned to the United States for alleged tuberculous infections. In order to establish the diagnosis of tuberculosis beyond all doubt, before a man could be sent home for this cause from the A.E.F., the following procedure was adopted. All the suspected cases of tuberculosis were kept together in separate wards under the charge of medical officers, particularly qualified to observe them. Repeated careful physical examinations were made, and the physical findings were invariably checked up by stereoscopic roentgenograms. The patients were kept at rest, and their temperatures were taken and recorded routinely. In addition to other routine clinical examinations, almost daily sputum examinations were made. Before any patient with suspicious physical signs or a suspicious roentgenogram was regarded as non-tuberculous, not less than *ten* negative sputum examinations were required. Except in cases where the physical signs were unusually outspoken and definite, the diagnosis of tuberculosis was practically confined to those who had positive sputa. Of the large number of suspected cases of tuberculosis that came under observation,

the majority were found to be non-tuberculous, only 189 were proved to be positive. Of these 169 were sufficiently definite to send to a base port with the recommendation that they be returned to the United States. In 17 instances, men who were tuberculous, were kept in France and returned to some form of light outdoor work. Three died of well-advanced tuberculosis.

Our experience coincided with the observations of Colonel Gerald Webb, who so ably supervised the tuberculosis problem in the A.E.F., namely, that many cases that were convalescent from influenza, pneumonia and bronchopneumonia, were mistaken for pulmonary tuberculosis because of persistent residual signs in the chest. Weeks and even months after these infections, men were found who still had areas of impaired resonance, harsh breathing and scattered crackling râles. It was also observed that tuberculosis was rare after gassing, in spite of French opinion to the contrary. The diagnosis of deep-seated tuberculosis at the root of the lungs, frequently proved a difficult matter. Other stumbling blocks to the diagnosis of this disease, were the transient atelectatic râles often heard at the apex, and the marginal râles described by Bushnell. This careful and thorough method of studying tuberculosis proved not only of value to the soldier, for many a suspected cases was found not to have the disease, but also to the Army, for by this method undoubtedly many a man who might have been evacuated from France as tuberculous, was kept in the A.E.F. and ultimately returned to active duty at the front.

Various acute contagious diseases, which proved such a problem at many of our base hospitals in America, with us fortunately never attained serious proportions. Measles, diphtheria, scarlet fever, mumps, various forms of meningitis occurred from time to time, but their number was never sufficient to prove a serious menace, and the small epidemics of diphtheria and scarlet fever that developed, were purely local in their origin and extent, and were undoubtedly examples of ward infection. There were five cases of meningitis due to meningo-

coccus, of which three died in spite of active treatment with anti-meningococcic serum. Two cases of pneumonoccic meningitis also succumbed.

As has been pointed out, chronic visceral diseases formed a negligible part of the medical service even in a base hospital. Only 44 cases of chronic organic heart disease were observed, and of these 14 were so slight or so well compensated that they were returned to duty. Gastric and duodenal ulcer were found in only 6 cases. In 15 soldiers the diagnosis of hyperthyroidism was reasonably refinite. From time to time occasional cases such as diabetes mellitus, Hodgkin's disease, myocarditis and pernicious anæmia were encountered.

From what has been said, it will be seen that the medical service at an average base hospital in France, was concerned largely with the management of acute conditions, particularly those conditions that were the outcome of battle, notably the various effects of poisonous gas. In addition, certain acute infections, as well as inflammations of the respiratory tract and intestinal canal, were conspicuous. The chronic visceral diseases, which play so important a part in the medical service of every general civilian hospital, and which furnish such valuable opportunities for study and observation, were noteworthy for the infrequency of their occurrence. It must be admitted, that the more varied clinical material encountered in our hospitals here at home is of greater interest to most internists than the somewhat monotonous stream of acute conditions that passed under their observation in France. Nevertheless, much valuable material was studied in the A. E. F. base hospitals and many a lesson learned in the management of our sick soldiers will prove helpful in these happier post-bellum days.

DISCUSSION.

DR. WALKER: I saw a number of cases in the base hospital in Paris. I was struck also by the same conditions where the physical signs and clinical symptoms the patients show a high temperature, rapid pulse, but show no localized symptoms of infected lung.

Regarding prophylaxis, we used the most in the early stages of the disease and toward the end of the disease.

Dr. John D. Thomas: In our hospital (Base Hospital No. 41) in the district of Paris, through which some 10,000 to 12,000 cases passed, there were only two or possibly three cases that could be classed as belonging to the typhoid group. And this was particularly interesting as from the first part of August, 1918, for several weeks we acted as an evacuation hospital, receiving the men who were operating just beyond Chateau Thierry and across the Marne. Later we acted as a base hospital. One case, the most marked one, could only be diagnosed clinically, as no bacteriological examinations showed any positive typhoid sign.

The post-influenzal lung cases were most interesting from two points particularly: (1) Often the inability to diagnose pneumonic complications early by the physical signs alone; (2) the long continuance of the pathological conditions in the lungs and their similarity in clinical and x-ray signs to tubercular lesions. Many of the latter cases were, I undertsand, sent back to the states as tubercular cases, and upon reaching this side after the long rest and sea air were pronounced non-tubercular.

DILATATION OF THE BRONCHI.

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A Review of Forty Cases Observed June, 1918–June, 1919.

Although dilatation of the bronchi was mentioned by Störck in 1761, the first anatomical and clinical account of the disease was given us by Laennec in 1819. In his first edition he says: "The organic lesion which I am about to notice seems to have been hitherto entirely overlooked both by the anatomist and the practitioner." He then proceeds to give "a short account of this rare lesion" and details two cases furnished him by M. Cayol, who as a medical student in 1808 first directed his attention to the affection. Six years later, in his second edition he writes: "The dilatation of the bronchi without being a very common affection is, however, much less rare than I long conceived it to be . . . within these last six years I have met with a great many instances of it."

The frequency with which this disease is confounded with tubercle of the lung and chronic bronchitis has led me to record some of the cases which I have seen during the past year. It is not a rare disease and its presence is frequently overlooked. The cases reported represent most but not all of the cases seen during this period.

A number of case histories have not been available for this short review. Most of the cases were returned soldiers paraded before me for recommendation as to disposal. The remainder were cases seen at the special chest clinics at St. Michael's Hospital and the Hospital for Sick Children, with five from other sources.

I shall not attempt within the limits of this paper to discuss morbid anatomy or the treatment of the affection.

The disease is usually secondary to disease of the bronchial wall, lung or pleura. J. K. Fowler, in a study of 35 cases with autopsy reports at Brompton Hospital during a period of seven years, analyses the origin thus,

	No. of Cases
Acute bronchitis	1
Chronic bronchitis	7
Syphilitic stenosis of the bronchi	1
Pressure on bronchi by a mediastinal growth or an aneurysm	1
Foreign bodies in the bronchi	2
Bronchitis and asthma	1
Bronchopneumonia	5
Lobar pneumonia	2
Chronic pneumonia and cirrhosis of lung	5
Pulmonary tuberculosis	4
Pleurisy and empyema	3
Hydatid cyst of the kidney	1
Spinal curvature	2

Lord of Boston and Boggs at Johns Hopkins have published cases which point to influenza as a causative factor, and the studies of influenza in the epidemic of last winter have shown us the intense inflammation and destruction which take place in the bronchioles in the virulent forms of this disease. In the severe cases which have recovered we may expect that some at least will have permanently damaged bronchial walls and numerous cases of dilatation will surely develop.

In gas poisoning, bronchiectasis has occasionally resulted, doubtless from the damage done to the bronchi and aided by a degree of pulmonary fibrosis which has followed the purulent bronchopneumonia or bronchiolitis which was not infrequent after chlorine and mustard gas.

Diagnosis is summarized thus by Samuel West.

"For the diagnosis of bronchiectasis we require (1) evidence of the existence of a cavity, and (2) reasons for believing that the cavity is a dilated bronchus. The first may be a matter of

fact, the second of opinion, and thus the diagnosis of bronchiectasis must in the nature of things be nearly always uncertain and often impossible.

"The bronchiectatic organ of the cavity is a matter of opinion only, and if it be difficult, as it so often is, after death, even with the help of the microscope, to decide the question, it must be frequently impossible during life.

"Stokes laid down the rule that when the signs of cavity had existed long without change, and without the development of phthisis, especially if the cavity were in the base of the lung, the diagnosis of bronchiestasis was justified. It is at any rate upon these data that the diagnosis is usually made, but as no account is taken of the fact that similiar cavities may develop as the result of suppuration or gangrene after pneumonia or in the course of chronic tuberculosis, the data are obviously insufficient. It is always misleading and often incorrect to speak of such cavities as bronchiectatic, and it would be more accurate to describe them by the term chronic excavation of the lung, which in fact involves no theory."

The diagnosis of bronchiectasis when such marked clinical signs are present, can usually be made, though difficult when the lesions are apical as illustrated by the cases recorded by McCrae and Funk. A generation ago the diagnosis of tubercle of the lung was rarely attempted except in the presence of cavity signs or of grave constitutional symptoms associated with changes in percussion note and on auscultation. Yet with practically no addition to our armamentarium other than the demonstration of the tubercle bacillus, earlier diagnosis was made and today even before the appearance of positive bacteriological findings and in the presence of only slight physical findings we do not hesitate to make an early diagnosis.

The time has come when the diagnosis of dilatation of the bronchi may frequently be made in absence of definite cavity signs. Only within the past three years is there anything to be found in the literature of the subject to help one in diagnosing

the condition early. Ewart in Allbutt and Rolleston's "System" considers that when originating in a general bronchitis, dilatation in its earlier stages can only be inferred. As to its differentation from phthisis, he considers that bacteriological examination of the sputum now decides the question after consideration of the clinical history, the general clinical state and aspect and the physical signs. McPhedran in his excellent article in Osler's "Modern Medicine," also emphasizes the value of history in the diagnosis. With careful attention to these points as outlined, a diagnosis can in many cases be inferred long before the presence of physical signs of extensive or long standing disease.

When the presence of the disease is inferred, the diagnosis can, in the majority of cases, be confirmed by the x-ray examination. It is only in recent writings that the value of the x-ray has been pointed out. In a valuable text book on the x-ray brought out only last year in English, the statement is made that the x-ray is practically of no service in the diagnosis of this disease and this appears to be the attitude of most writers on respiratory disease, even of recent years. This, I am certain, is due entirely to the use of the single plate which is of value only in the case of large dilatations or of dilatations of the main bronchi. Even the stereoscopic plate as produced in many hospitals is of little service; frequently the plates lack the detail necessary for outlining the bronchial tree, but roentgenograms of the chest, properly made, usually show the dilatations beautifully, and after seeing what can be done by an expert operator, one cannot fail to recognize what an enormous waste is going on in the production of inferior work, which fails to demonstrate this not infrequent bronchial lesion. Stereoroentgenograms are as important in the diagnosis of early or deep seated bronchiectasis as is the tubercle bacillus in the absolute diagnosis of tubercle of the lung.

CASE I.

3 A.M. Ray, S. G.

October 23, 1918: Had bronchitis on enlistment and the cough has not since cleared. The chest shows no signs of disease but in view of his persisting cough x-ray plates have been ordered.

Stereo-x-ray plates show bronchioles left upper lobe dilated longitudinally. Saccular dilatation of bronchioles in left middle and lower areas near the hilus and extending into the lower lobe. None of these dilatations extend far from the hilus. Left hilus, upper and lower, shows heavy cotton wool shadowing with radiations. Right hilus shows markings branching into the right interscapular area with a few small nodes, which are also present in lower lobe branches on the right.

Right diaphragm clear but irregular.

Diagnosis.—Chronic bronchitis with bronchiectasis.

CASE II.

Pte. Chapple. Age 30 years.

Spent four months in hospital with diagnosis tubercle of lung, onset with pleurisy. Half of time in bed, half as an up patient with transient fever. No tubercle bacilli any time present.

July 7, 1918: General condition fair. Weight stationary, with loss of 20 per cent. Morning cough, varies with posture. Dyspnœa on exertion. Pain left lower chest. Working ability six hours. Sputum one ounce, foetid, periodic, increased lying down. Tubercle bacilli found while under observation.

Physical Examination.—Slight retraction, lower left chest with inspiratory indrawing sixth space. P.M.I. fifth space, nipple line. Localized dulness fifth and sixth spaces with faint breath sounds with constant consonating rales and sibili.

Slight clubbing of fingers.

X-ray shows bilateral dilatation of bronchi. Multiple bilateral saccular about right and left hilus but most marked in left, also right from hilus to base. Evidence of old tubercle about the hilus.

Diagnosis.—Tubercle of lung with bronchiectasis about hilus but particularly left lower lobe.

Case III.

Pte. P. G. Age 20 years. Height 62 in. Weight 175 lbs.

Two years ago inflammation of lungs, in bed over a month, since then well until June, 1918, three months after enlisting, when following exposure on route march, took cold, and cough has persisted. July, hæmoptysis. 2 ounces.

Physical examination. September 8, 1918: Right supra-clavicular fossa deeper than left. V.R. and V.F. slightly increased over right lower lobe behind. Breathing harsh over right side with prolonged expiration at right apex. Moist râles brought out by coughing over right lower lobe behind. Sputum examination negative for T.B.

Temperature over 21 days (July 20–August 9) subnormal except for rise to 99.2° on August 6, when he had a hemorrhage.

Referred M.D. No. 2 as tubercle of lung.

October 10, 1918: Nothing abnormal found on examination beyond slightly impaired resonance in left first and second interspace. Adventitious sounds are absent. Finger tips are cyanosed with swelling at back of nails.

X-ray plates show dilatation of bronchus near the hilus on both sides. His present condition is due to chronic bronchitis which is complicated by bronchiectasis.

Sputum negative for T.B. Temperature range normal. Lost 12 pounds weight.

Subjective.—Cough in mornings with 2 drachms grayish phlegm. Slight feeling of general weakness.

Diagnosis.—Bronchiectasis about right and left hilus with hilus tubercule.

Case IV.

Bandsman M.

June 29, 1918: Has had cough one year. Of late has had frequent hæmoptysis, one drachm to one ounce. Cough frequent. Sputum one ounce daily, influenced by postural change.

Overseas Diagnosis.—Bronchitis with debility.

Physical examination shows marked general emphysema with left basal pleurisy and high adherent diaphragm. Fingers are slightly clubbed.

X-ray examination shows general heavy shading of bronchial tree. Dilated bronchi in left lower lobe with shadows suggestive of old hilus tubercle.

CASE V.

Pte. B. C. S. Age 45 years. 60 in. 133 pounds.

Heavy colds every winter for past six years. Became worse with wet weather in England. Returned to Canada because of bronchitis.

June 28, 1918: Weakness, persistent cough and shortness of breath on moderate exertion. Sputum two ounces daily, mucopus, odorless.

Objective.—Sternum is rather prominent. Deep antero-posterior diameter. There are localized râles with slight dulness in second right interchondral space also below fourth rib right anterior and lateral. There is marked clubbing of fingers and thumbs and great toes. No T.B. in sputum. Temperature normal. Has chronic cough.

Wassermann—negative.

X-ray plate shows bronchiectasis right upper lobe second space also in right lower lobe out from hilus, about left hilus also the bronchi of left lower lobe are dilated. Right diaphragm high.

Diagnosis.—Bronchiectasis, right upper and lower lobes, and about left hilus.

CASE VI.

Lieutenant R. M.

October 12, 1918: He states he had a slight cough last autumn and carried on until his trench fever and shell gas poisoning in November. He has about one half ounce mucoid sputum and sleeps poorly. He is short of breath on exertion and has lost 20 to 25 pounds in weight. His condition is probably aggravated

by exposure following the torpedoing of his ship en route from England. On examination the chest is flat and both apices narrowed and dull on percussion, especially on the right. Breath sounds are normal, but there are fine râles over the left clavicle. Percussion resonance is impaired on each side to the second rib.

Repeated examination of the sputum shows no tubercle bacilli. X-ray plates indicate a quiescent healed tuberculosis of the right upper lobe, chronic bronchitis with bronchiectasis in the right upper lobe.

CASE VII.

Cpl. F. E. G. Age 26 years.

Subject to winter colds. Had pneumonia three times before enlisting. Influenza August 10, 1918, at Niagara Camp, followed by pneumonia.

June 12, 1918: Troublesome cough. Sputum becoming free. Good color. Nutrition fair, though says he has lost 30 pounds of which has regained 6 pounds.

Left chest lags and moves less than right. Resonance impaired below fifth rib anterior, sixth axilla, sixth posterior. Little movement of lower border of left lung. Showers of moist râles over whole left lung after cough, greatest at lower part and superficial.

February 25, 1919: No elevation of temperature. Still many superficial crepitations over lower lobe apices posteriorly.

Examination of sputum. Shows presence of many bacteria—pneumococcus, staphylococcus, streptococcus, catarrholis, etc. No tubercle bacilli.

March 7, 1919: Poor movement of lower border of left lung anteriorly, few crepitations axillary line.

X-ray shows slight scoliosis to left. Left Diaphragm high. Heart displaced to left. Right hilus, heavy and matted. Vertical bronchus and first and second interspace branches are heavy with few densities, small, at bifurcations. Lower lobe trunks are heavy and wide and matted in inner third.

Left bronchial tree from first space is heavy and trunks are

irregularly wide, especially anterior branches which can be traced to periphery where pleura appears thickened.

Diffuse bronchiectasis of middle area of left lung. Slight about right hilus. There are old tuberculous deposits. Sputum examination. February 28, 1919, tubercule negative, January 3, 1919, mucopurulent, polymorphs + + , monos. + + , Epith. + + , gram. cocci. + + , streptococci + + , pneumococci + + , catarrhalis gram. + , bacilli + + .

Eight subsequent examinations of sputum, tubercule negative.

Case VIII.

Gunner H. D. W. Age 20 years. Height 67 in. Weight 127 lbs.

Cough persistent since pneumonia, 1917. Treated in hospital and sanatorium for one year as tubercle of lung.

August 23, 1918. General condition fair. No loss of weight. Marked weakness associated with prolonged rest in bed and frequent severe hæmoptysis. Cough rather continuous. Sputum two ounces daily usually intimately mixed with pink. Frequent hemorrhage one to four ounces, odorless. No T.B. at any time.

Physical Examination.—Pale but well nourished. Physical signs almost nil. Few rhonchi posterior left, disappeared with cough.

X-ray shows marked widening of the large bronchi in both lower lobes.

Diagnosis.—Bronchiectasis. No definite evidence of tubercle.

Case IX.

Pte. T. C. 30 years. 69 inches. 140 pounds.

Bronchitis began in England, 1900. Was in a sanatorium nine months. Came to Canada following spring, where he made marked improvement. Had a slight winter cough subsequently but not troublesome until he enlisted and went to England in 1916.

Subjective.—Weakness. Shortness of breath after slight exertion such as going up stairs and walking fast. Coughs a good deal, especially in the mornings, with expectoration, two ounces of dark yellow mucus.

Objective.—High sternum above, clavicles prominent. Chest movement fair, same on both sides. No definite dullness, no bronchial breathing. Diffuse sibilant râles at apices and bases, no moist râles; no clubbing of the fingers. No record of fever. Repeated sputum examinations T.B. absent.

X-ray stereo shows lung quite clear. No heavy deposits to suggest tubercle. Bronchial tree shadow rather heavy in lower lobes with dilatation in the right tree.

Case X.

Gunner F. W. G. Age 28. 69½ in. 136 pounds.

Health good prior to enlistment though always subject to colds. Admitted to hospital, England, January 18, 1918, as purulent bronchitis. Invalided to Canada, May, as bronchitis.

October 22, 1918: Shortness of breath after slight exercise, slight cough, sputum has gradually lessened, only a trace. Had pain in subclavicular region, none now. Expansion fair and equal. Harsh breathing under left clavicle. No dulness. No adventitious sounds.

Stereoscopic plates show dilatation of large bronchi left and right. Repeated sputum examinations show no tubercle bacilli.

Wassermann: Negative.

Case XI.

Pte. J. M. Age 20 years.

January 11, 1919: Cough has persisted for one year. Influenza overseas eight months ago while in hospital in England with G.S.W. left forearm. Loss of weight 14 per cent. Cough particularly at night, varies with posture. Sputum one drachm, periodic, no blood, more lying down. T.B. absent on repeated examinations. Pain upper and lower left chest.

Physical Examination.—Friction rub left infrascapular with high diaphragm, restricted excursion. An area over left third rib anteriorly with a few râles after cough. Fingers and toes clubbed. Because of wasting of muscles clubbing appears greater in left hand.

X-ray-stereo shows unilateral multiple saccular dilatations about upper pole left hilus associated with numerous small calcareous shadows, diaphragm fixed with slight pleural thickening at base. Left vertical bronchus mottled. Pulmonary area clear.

Case XII.

Pte. Fitz. Age 30.

Two months ill 1903 lead poisoning. Pneumonia at Valcartier, 1916. To France 11/3/17. Became wheezy and short of breath. Sent to England as G.S.W. Arm and Asthma, 11/1/18.

Invalided to Canada with amputated right arm and tubercle of lung. Six months in hospital. An up patient with transient fever.

July 10, 1918: Working ability, nil. He is thin, weak. Almost continuous cough. Sputum not varying with posture, three ounces, particularly morning, odorless. No T.B. on repeated examinations.

Physical Examination.—Moderate emphysema. Impaired resonance to second rib right and left with little movement. Both S.S. fossæ dull. No râles. Localized area left infrascapular with dulness, broncho-ves. breathing and constant, localized small râles. Marked clubbing of fingers. Slight clubbing of toes.

Stereo-x-ray shows old tuberculous lesion left and right apex with bilateral cylindrical and saccular bronchial dilatations in right and left upper lobes and also in left lower lobe. Numerous calcareous shadows in hilus. Right diaphragm slightly blurred.

Diagnosis.—Bronchiectasis with healed tubercle of lung.

Case XIII.

Pte. F. H. F. Age 22 years.

April 24, 1919: Pleurisy and pneumonia at age of five years. Family moved from England to Canada on account of this boy's health, three years later. Since coming to Canada has had no illness but has always had cough and sputum. Dyspnœa on exertion and frequent colds with only temporarily increase of sputum. Enlisted early in 1916, went to England, August, 1916; France, December, 1916, and carried on in line until gassed in September, 1918. Invalided to England. Severe gas poisoning. Discharged from hospital February, 1919, and returned to Canada for demobilization.

There is considerable cough and one ounce purulent sputum daily. There is about eight pounds loss of weight. Fingers are somewhat short and stubby.

Chest: Right lower chest moves less than left. Impairment of resonance over whole right chest especially from apex to second rib and to spine of scapula, and below fourth rib in front and eight rib, posteriorly. Whispered voice increased over right upper lobe and expiration prolonged with a few whistling rhonchi. Over lower dull area many medium moist râles are heard; expiration not especially prolonged. No marked difference in vocal fremitus or resonance. Right diaphragm is high and adherent.

X-ray shows many dilated bronchi.

Diagnosis.—Bronchiectasis and fibrosis of right apex.

Case XIV.

Pte. F. H. R. Age 31 years. 65 In. 142 pounds.

Patient has had cough and sputum since 1903 when he had "slow pneumonia," in bed 6 weeks. Has had "pneumonia" on several occasions, but only ill for a few days. Some cough has persisted. He has never lost weight except for a short time while in France. He has convergent strabismus of left eye antedating enlistment. There is slight stammering which dates from childhood.

Subjective.—There is moderate amount of cough and very small amount of purulent sputum. There is dyspnoea after moderate exertion.

Objective.—There is marked retraction of left chest with very little movement during respiration. There is heaving praecordial pulsation extending out to axillary line in fifth interspace. The right side of the subcostal angle is much greater than left. There is high pitched skodaic resonance with bronchial breathing and no râles over the left upper chest with absolute dulness below fourth rib in front. There is evidence of large cavity extending from axillary region at level of fourth and fifth ribs to scapular region at level sixth and seventh ribs. Cracked pot resonance, metallic râles, amphoric breathing, pectoriloquy. The fingers are slightly clubbed.

Diagnosis.—Fibrosis of left lung with bronchiectasis.

Case XV.

Pte. L. M. Age 30 years. 65 in. 118 pounds.

Cough dates from May, 1917, with history of chronic bronchitis.

September 25, 1918: There is considerable cough with morning expectoration which is purulent and sometimes sanguineous. There is considerable wheeziness. Dyspnœa is present after moderate exertion, *e. g.*, running 30 yards.

Objective.—Sputum about two ounces in 24 hours. There is moderate clubbing of fingers. Chest is semi-rigid with moderate kyphosis. There is some impairment of resonance of right upper lobe. Breath sounds are every where harsh with sonorous and sticky râles, heard both behind and in front of chest, especially over lower lobes posteriorly.

X-ray shows multiple bronchiectasis about hilus and portions of both lower lobes. Sputum has never shown tubercle bacilli.

Diagnosis.—Bronchiectasis, principally lower lobes right and left, with emphysema.

Case XVI.

Pte. D. M. Age 32 years. 69 inches. 137 pounds.

Enlisted May, 1915. First taken sick in February, 1918, with cough and pains in chest. Was sent to hospital in France and then to England.

April 2, 1919: *Subjective.*—Is not feeling up to his general health; coughs a great deal during the day and night, expectoration one cup yellow green phlegm, odor is foul. Sleeps fairly well and is propped up in bed, which gives him relief. Shortness of breath on climbing flight of stairs slowly. Pulse 82, resp. 20, sitting; touching ground 10 times, P. 120, resp. 26, with distress, returns to original in 1½ minutes. Apex beat at nipple line.

Objective.—Rather poorly developed and nourished. Has cyanotic tint to face. Marked clubbing of fingers. Breath very foul. Chest emphysematous, moving as a whole. General hyper-resonance, cardiac dulness almost lost. Numerous râles heard posterior part of chest, disappearing on coughing.

Stereo plates show right hilus dense, lower pole heavy and heavy bronchial roots to lower lobe. Bronchus heavily shaded and appears to have an irregular diameter. Left hilus somewhat heavily shaded but less than right. In area between fourth space anterior and eighth space posterior are mottled shadows of irregularly dilated bronchi. Lower lobe bronchial tubes overlying heart shadow show cylindrical dilation. Left first costal cartilage calcified, more so than right.

Diagnosis.—Bronchiectasis. Disability practically total because of very troublesome cough and odor present in sputum.

Case XVII.

Pte. E. A. W. S. Age 29 years. 70 in. Weight 142 lbs.

Has been subject to winter colds for years. Has not been without cough and sputum since he went to England, June, 1917. Pleurisy of left side, February and March, 1918.

February 18, 1919: *Subjective.*—There is cough and purulent sputum about 2 oz. in 24 hours. There is dyspnœa after moderate exertion, *e.g.*, running 50 yards. Sputum has never shown presence of tubercle bacilli. There is a fœtid odor to sputum and to breath after coughing.

Objective.—Fingers are clubbed. Hands are cyanotic. Right chest is slightly smaller than left, with slight droop of right shoulder. Right nipple lower than left but right subcostal angle is not narrowed. Slight diminution of expansion of right chest. There is slight change in percussion note over left lower lobe; there is a blowing quality to inspiration around angle of left scapula and rhonchi are heard with cough in this area and around axilla.

Stereo-x-ray of chest shows diaphragm normal, moderate scolosis, convexity to right, in region seventh, eighth and ninth ribs. Right upper chest slightly smaller than left; Right hilus is heavy with fluffy shadows in lower pole. Upper three quarters right lung is fuzzy with bronchial trunks faintly outlined. Lower trunks are matted. Lower lung area is clearer than normal. Left hilus shows fluffy shadows with a number of calcareous shadows well out. Vertebral trunk is dilated to apex. Middle area of left lung—bronchial trunks difficult to trace because of irregular shading. Lower lobe trunks are heavy and blur out line of heart shadow. They appear definitely dilated from fourth to seventh rib outside heart shadow and especially in cardio-phrenic angle.

Diagnosis.—Diffuse bronchiectasis of left lower lobe and generalized bronchitis.

Case XVIII.

Spr. E. J. P. Age 17 years.

Invalided to Canada as tubercle of lung.

March 11, 1919: Cough slight, when he walks fast it is worse, spits up a brownish sputum, never coughs at night or in the morning. No night sweats. Weight increasing.

Repeated sputum examinations show no T.B.

March 13, 1919: Expansion equal and good 3 inches, chest well-formed, symmetrical, very slight impairment resonance, right, down to third rib. Right diaphragm high but freely movable. Right front from third to sixth rib and along same level in axilla a few bubbling or gurgling râles, increased after cough. In this area whispered voice is increased. On left side, middle and lower areas, an occasional piping rhonchus is heard.

Prov. Diagnosis.—Chronic bronchitis with bronchiectasis.

Opinion.—With cough persistent since childhood and not increased on service, no T.B. found at any time and physical signs principally in lower lobes, absence of fever during months of observation, diagnosis of tubercle of lung is not concurred in. History of having hemorrhage fits in with bronchiectasis.

X-ray shows moderate high diaphragm, normal shape, broad heart shadow right border lost in heavy right hilus shadow. All bronchi about right hilus show dilatations, some extending well out into the middle pulmonary area and along vertical bronchus well to the apex. On left side also, sacculated dilated trunks close to hilus. The left vertical bronchus is mottled as well as dilated.

Opinion.—Picture is one of bronchiectasis about the hilus but extending into lung on right side, possibly some old inactive peribronchial tubercle about the vertical bronchi.

Diagnosis.—Bronchiectasis present on enlistment but aggravated by service.

Case XIX

Pte. W. L. C. Age 33 years.

March 13, 1919: Has lived in California and Mexico for past seven or eight years. Was born in Regina and went south because he was subject to colds. In the south he was comparatively free of colds. On the way to England in April, 1918, he caught cold and was unable to get rid of it. Soon after arrival began spitting up blood, streaking of sputum. Was sent to hospital, Bramshott, about June 1—diagnosis hæmoptysis. While there frequent examinations of sputum never showed presence of T.B.

but streaking of sputum continued. Last noticed in sputum about one week ago.

Cough is variable and spasmodic. Becomes very troublesome after a fresh cold of which he has had four in last month. Sputum is much increased after colds and is usually blood streaked. Amount at present is about one-fourth sputum cup.

April 3, 1919: Complaining to-day of steady cough, spits up some clots of blood and a good deal of yellow mucus or brown stained sputum. No night sweats. Weakness after walking brings on severe coughing spells. There is wheezing frequently in A.M.

Chest: Wide subcostal angle, short and broad chest. Semi-rigid. There is impaired resonance of right apex down to third rib with prolonged expiration and a few rhonchi. Posteriorly over right lower lobe are many whistling rhonchi which clear with prolonged coughing. Similar over lower lobe of left lung but less marked than on right side.

X-ray shows dilated bronchi about right hilus, some dilations about left.

Diagnosis.—Bronchiectasis.

Case XX.

Spr. H. C. Age 20 years.

June 21, 1918: Had spent two years in hospital and sanatorium as tubercle of lung. Pleurisy left base at 14.

Examination.—General condition good. Working ability one quarter. Slight weakness. Loss of weight 5 per cent. Dyspnœa on exertion. Pain lower left chest. Sputum two ounces, fœtid, periodic, more on lying down and especially on back. Many organisms present. No T. B. at any time.

Physical Examination.—Slight dulness with cavernous breathing and consonating râles in localized area fourth to sixth space, left anterior. Left infrascapular slightly dull with distant cavernous breathing and bronchophony. Slight clubbing of fingers, none of toes. No fever recorded during two years in

hospital. X-ray shows left upper main bronchus dilated, heavy left hilus with multiple localized dilatations in left lower lobe. Shadow of calcareous deposit in left hilus.

Diagnosis.—Bronchiectasis left, particularly lower lobe.

Case XXI.

G. Wilkins. Age 40 years.

January 31, 1919: Nine months in hospital. No previous illness. Three months in bed. Began with symptoms of chronic bronchitis. Sputum more on lying down. T.B. absent on all examinations. Fœtid odor. Marked clubbing of fingers and toes.

Physical Examination.—Area of impaired resonance about and below inferior angle of left scapula with coarse bubbling râles almost consonating, with bronchial breathing.

Chest generally barrel shaped with area S.C.D. lost.

X-ray shows multiple saccular dilatations in left lower lobe well out from hilus with dilatation of the larger trunks.

Case XXII.

H. M. Age 26 years. Height 67½ inches. Weight 140 pounds. 3 years ago weight 163 pounds; 1 year ago, 146 lbs.

Gassed, 1916. Invalided home. Discharged March, 1917. States he was cured of chest trouble before reenlisting in June, 1917. Influenza, May, 1918.

March 3, 1919: Patient states that he has had a cough for over two years with small quantity of sputum; says he has blood sputum once or twice a week. Some difficulty in breathing at times. States he lost 42 pounds following influenza last May. Feels nervous all the time. Since influenza appetite has been poor. Nauseated at times and has vomited once or twice. Formerly had some gastric disease but this has disappeared.

Physical Examination.—Nutrition fair and color good. Expansion fair and equal.—Negative on percussion and auscultation except for an occasional sonorous râle. Heart sounds clear.

Pulse 90 at rest, 120 after exercise, touching floor 12X Resp. 32 with some dyspnœa. Patient coughs frequently.

March 11, 1919: Sputum is blood stained—with small clots and a pinkish tinge to whole—several examinations negative to tubercle.

April 22, 1917: Chest is semi-rigid. No retraction or impairment of resonance, equal and fair expansion of chest. Lung borders move well. Few sonorous râles heard over both lungs posteriorly, otherwise respiratory murmur is normal.

X-ray shows bronchial tree well outlined with definite dilations of bronchi in lower lobes especially in right. No evidence of tubercle of lung. Sputum is blood tinged especially after "colds," which are frequent. Examination of sputum is negative for tubercle but contains considerable flora of pyogenic organisms. Pulse at rest 76; after flight of stairs, 104. Returns in one minute with slight respiratory distress.

Subjective.—There is cough and muco-purulent blood stained sputum, 3 oz. in 24 hours. There is some substernal pain at nights, worse after a fresh cold. There is dyspnœa after exertion, *e.g.*, running 75 yards.

Diagnosis.—Bronchitis with bronchiectasis.

Case XXIII.

Pte. J. C. M. Aged 20 years. Height 68 inches. Weight 126 pounds. No previous illness. Gassed September 7, 1918. Medical sheet records conjunctivitis, laryngitis, burns of scrotum, bronchitis.

November 26, 1918: Cough, tightness across front of chest, short winded. General condition good, color and nutrition excellent. Voice a little hoarse. Chest shows scattered moist râles, but the breath sounds are otherwise clear and normal.

September 1, 1918: Right upper chest is smaller than left, with slight dulness along right clavicle and down to third rib. Both apices are narrow, right more so than left. Breath sounds are harsh everywhere, with high-pitched musical râles, especially over both lower lobes posteriorly.

January 14, 1919: There is little sputum but considerable cough. There is dyspnœa after moderate exertion; is easily fatigued.

Few mucous clicks heard over right upper lobe posteriorly, expiration prolonged over both upper lobes in front.

February 20, 1919: No T.B. in sputum on repeated examinations.

Subjective.—There is cough and morning purulent sputum 3 oz. in 24 hours. There is dyspnœa on moderate exertion, *e.g.*, running 75 yards.

X-ray Report.—Throughout the chest there is extensive fibrosis particularly marked on the right side.

Along the course of the right vertical bronchus and extending out into the first and second interspace trunks on this side, there is considerable matting, small fibrotic nodules are frequent, and these extend far out into the periphery of the lung tissue.

The left hilus is thickly studded with calcified nodules and the vertical bronchus shows considerable matting, and numerous calcified nodules along its course also. In the left hylus, however, are small bronchiectatic cavities. This is present in a less marked degree in the right hilus also.

It is difficult to arrive at an accurate interpretation of these plates, but it is my opinion that a double process is represented here, that in the hilus being bronchiectasis, and that extending up into the apices and the interspace trunks, probably being an old tubercular infection. There is no gross disease, and no very extensive localized lesion and no evidence of present activity.

Diagnosis.—Small localized saccular bronchiectasis in both lung roots and probably tuberculous involvement in the apices and vertical bronchi. Bronchitis and bronchiectasis with quiescent pulmonary tuberculosis.

Case XXIV.

Pte. J. R. Age 30 years.

Pleurisy left base, 1915, preceded by bronchitis. Chronic

bronchitis, winters, 1916–1917. In hospital six months as tubercle of lung. As up patient with transient fever. No T.B. in sputum. Working ability one quarter.

July 14, 1918: General condition good. Loss of weight 8 per cent. More or less continouus cough, varies with posture; sputum two ounces, odorless. Dyspnœa on exertion. Pain left lower chest.

Physical Examination.—Lessened movement of left chest with contraction in area fourth to seventh rib anterior and axillary, with marked dulness and loud bubbling consonating râles. Corresponding posterior area about angle of left scapula with dulness and coarse râles. A few crepitations about right nipple. Fingers and toes clubbed.

X-ray shows uni-lateral localized saccular dilatation in left lower lobe with associated slight hilus shadows and heavy bronchial shadows. Left diaphragm blurred.

Diagnosis.—Bronchiectasis left lower lobe.

Case XXV.

Pte. B.

Cough began June 14, 1916, day after gun shot wound of thigh. Returned to Canada, December, 1916, as chronic bronchitis.

Readmitted Spadina Military Hospital, June 1, 1918. Severe cough, three ounces purulent sputum. Fingers clubbed.

Physical Examination.—Dulness with signs of multiple small cavities, left lower lobe, some rhonchi over right lower lobe. P.M.I. displaced outward, no movement of left lower lung border.

X-ray shows no movement left diaphragm, high, adherent. Hilus shadows heavy in the left lower lobe. Behind and outside heart shadow, heavy bronchial shadows rather flocculent with a multiple dilatation of bronchioles. Heart much to left.

Case XXVI.

Ethel M. Age 14 years.

March 17, 1919: Cough from infancy, began at two weeks of age, aggravated by whooping cough at six months and two attacks of measles. Troublesome cough. Sputum 4 ounces daily, purulent, odorless, frequently blood-streaked. Nutrition good. Fingers slightly clubbed.

P.M.I.: fifth interspace outside nipple. Left chest moves little and upper lobe impaired. An area of dulness, right infrascapular. Uncertain and shifting râles and rhonchi throughout the chest. Sputum repeatedly negative to T.B. Tuberculin —no reaction.

X-ray.—Ribs appear horizontal. Dilatation of bronchi about right and left hilus, extending further on the right. General increased clearness of lung.

Case XXVII.

H. B. Age 8 years.

January 20, 1919. Cough for three years following measles and pneumonia. Several coughing spells daily with much sputum each time. Half cup 24 hours. Sputum yellow. No odor.

Physical Examination.—Pale. Thin. Fingers clubbed. Cyanosed at tips. Left chest contracted. Shoulder and nipple low and left costal margin indrawn. Visible precordial pulsation third, fourth and fifth space. Dulness to left of heart extending to axilla and left infrascapular with uncertain bubbling râles, not consonating.

X-ray shows wide dilatation in bronchial tree, left lower lobe laterally and anteriorly, left diaphragm high and left chest contracted. Some dilatation in right hilus. Tuberculin—no reaction.

Diagnosis.—Bronchiectasis left lower lobe, slight about right hilus.

CASE XXVIII.

Lewis T. Age 8 years.

March 6, 1919: Had whooping cough at five. Always delicate. Subject to bronchitis but in fair health until last June, when he had a bronchitis which has persisted. At times is less but does not clear. Late in February had influenza. He has severe vomiting spells every day for past week, result of severe cough. Sputum one half cup daily.

Physical Examination.—Very thin and pale. Fingers bulbous, tips cyanosed. Chest thin. Expansion poor at bases. P.M.I. diffuse in fifth space. A few scattered râles over lower front right and left posteriorly. Marked dulness left infrascapular with bronchial breathing and consonating bubbling râles. Right infrascapular, slight impairment of resonance with numerous non-consonating râles.

Diagnosis.—Bronchiectasis of lower lobes, greater on left side.

Tuberculin negative.

CASE XXIX.

Florence W. Age 24 years.

Admitted October, 1918, following serious hæmoptysis. Had been at sanatorium one year for tuberculosis. Cough for three years following severe cold. Sputum gradually increased to two ounces daily, frequently pink in color, no odor, no tubercle bacilli found while in hospital and none during year at sanatorium. Fingers and toes clubbed. Slight reaction to tuberculin. Left lower chest moves slightly. Infrascapular dulness with limited area of high pitched bronchial breathing and consonating râles also bubbling râles.

X-ray shows numerous dilatations through left lower lobe a few in right.

CASE XXX.

Joseph L. Age 31 years.

January 23, 1919: Cough since March, 1915. Is positive had no sputum until two months ago when ill with "lung trouble."

Cough has persisted, but has been at work since December, is losing weight, debility increasing, working in dusty occupation. Temperature normal. Lost eight pounds. Is thin. Coughs mostly night and morning with half cup of sputum.

Physical Examination.—Negative. Sputum no tubercle bacilli.

X-ray shows dilated bronchi about right hilus limited to larger divisions.

Case XXXI.

Minnie M. Age 32 years.

June 6, 1918: Cough since December, 1916. Pleurisy, 1917. Sputum increasing to ten ounces daily. In June, 1917, hemorrhage two drachms, August 2 ounces. August, 1918, four ounces, and began to develop unpleasant odor which still continues. Still has occasional hæmoptysis, one ounce to a cupful often preceded by pink sputum. Odor now unpleasant. Repeatedly negative for T.B. Skin does not react to tuberculin.

Physical Examination.—Lower border of right lung high, moves little. Numerous localized râles somewhat consonating, and tubular quality to breath sounds right infrascapular. Occasional râles left infrascapular with no change in breath sounds.

X-ray shows numerous dilatations in bronchi of right lower lobe lying in dense pulmonary shadow. Slight dilatation of left lower bronchial divisions.

Diagnosis.—Bronchiectasis, particularly right lower lobe.

Case XXXII.

Madeline S. 10 years of age.

January 29, 1919: Some cough for three years following pneumonia, aggravated by influenza October, 1918. Since then troublesome cough persists with ten ounces purulent sputum. Is pale, finger tips cyanosed and slightly clubbed.

Physical Examination.—Right infrascapular area dull, as is axillary below fifth rib and the anterior part of lower lobe area; bubbling râles present in dull area. Diaphragm appears fixed. No reaction to tuberculin.

X-ray shows right diaphragm high in its inner third with adhesions. Hilus shadows heavy in upper poles; lower left is hidden by pulmonary shadow which extends out beyond heart border, in this are seen dilated bronchial divisions. Some dilatation close to left hilus in lower lobe.

Diagnosis.—Bronchiectasis with fibrosis of right lower lobe and basal pleural adhesions.

Case XXXIII.

Frances B. 2½ years.

February 26, 1919: Cough since measles six months ago, both day and night, loose, mucous, but does not expectorate. Mother thinks she swallows "a lot of phlegm."

General condition good, no fever, but does not react to tuberculin. There is an area of dulness with faint bronchial breathing and bubbling râles and rhonchi about inferior angle of right scapula.

X-ray shows slight contraction of right chest, heavy hilus shadows right with some dilated bronchi in lower lobe. Some scattered peribronchial densities in left upper lobe.

Diagnosis.—Bronchiectasis, right lower lobe.

Case XXXIV.

Fred G. Age 8 years.

Has had a chronic cough for five years. One previous admission to hospital for bronchitis, three years ago. Always a weak frail child. His mother has chronic bronchitis.

June 1, 1919: Poorly developed, poorly nourished, appears delicate. Coughs often, single, loose. Fingers slightly clubbed. Chest expansion equal, resonance slightly dimished over right infrascapular. Showers of small râles in both lower lobes posteriorly, more intense on right. No reaction to tuberculin. No T.B. in sputum.

X-ray shows multiple small saccular dilatations well out from hilus in right lower lobe, a few in left. Main divisions not dilated.

Diagnosis.—Bronchiectasis of smaller bronchioles lower lobes, principally right.

Case XXXV.

Arthur C. Age 12 years.

Had cough since influenza, November, 1918. Admitted to hospital, April, 1919, because of discharging ear with presence of diptheria bacilli. Was transferred to isolation hospital, re-admitted when clear.

June 1, 1919: Yesterday coughed up two ounces bright red blood, sputum ordinarily two ounces, heavy purulent, occasionally stained with blood. Patient is well developed, well nourished, but very pale. Fingers and toes slightly clubbed. Temperature rises usually to 100° in the afternoon.

Physical Examination.—Signs of high adherent right diaphragm with cavity signs and consonating râles about inferior angle right scapula, coarse râles and rhonchi general throughout right lower lobe. Little movement right lower chest, occasional rhonchi left lower lobe. Does not react to tuberculin. No T.B. in sputum.

X-ray shows widely dilated right main bronchus and branches in lower lobes. Increased density of pulmonary shadows with high immobile right diaphragm.

Diagnosis.—Bronchiectasis involving particularly larger divisions right lower lobe with old basal pleurisy.

Case XXXVI.

J. P. T. Age 33 years.

Cough in morning since pleurisy, 1908, recurring attacks of pneumonia since, always confined to left lower lobe. Sputum two ounces daily, purulent, rarely blood stained.

June 9, 1919: Left chest much contracted, anteroposterior diameter two thirds that of right, trachea passes behind inner end of left clavicle. P.M.I. fifth space outside nipple, little movement left chest. Harsh breathing above, marked dulness

fifth rib to base axillary and posterior with cavity signs and bubbling râles.

X-ray shows extensive fibrosis throughout left lung, particularly in lower lobe with widely dilated main bronchial branches. Mediastinum displaced much to the left, general contraction of left chest with kyphosis and marked scoliosis.

Diagnosis.—Bronchiectasis, left, involving the larger branches.

Case XXXVII.

I. H. 23 years of age. F.

Cough since childhood, sputum always free, purulent, rarely confined to bed but no day free from cough. Completed college courses satisfactorily.

February, 1918: Sputum four ounces daily, purulent, no fever, general condition fair, fingers clubbed. In left lower lobe axillary and infrascapular, slight dulness with harsh breath sounds and many bubbling râles, a few râles and rhonchi L.U.L. from second rib down to dull area.

X-ray shows heavy bronchial shadowing general in lower lobes and left upper with dilatation of main trunks about left hilus upper and lower, with involvement of smaller branches in lower lobe.

Diagnosis.—Bronchiectasis about left hilus and in left lower lobe.

Case XXXVIII.

R. C. Age 21 years.

Cough each winter since childhood, in 1912–13–14 persisted through summer, takes cold easily.

First examination, March, 1913. April, 1915, general condition excellent. Good color. Troublesome cough. Sputum two ounces purulent, no odor. Limited movement lower left chest with dulness lower axillary and infra scapular, distant bronchial breathing and many bubbling râles.

March, 1919: Developed into a big strong young man. For past two years cough and sputum have been lessening but

subject to increase at times in winter. Now has little and works steadily. Dulness has lessened. Left diaphragm moves little, no bronchial breathing in left lower lobe but a few râles present with cough. Fingers less clubbed.

X ray in 1913 showed heavy wide bronchi in lower lobes, greater in left.

Diagnosis.—Bronchiectasis in left lower lobe, bronchi bronchitis lessening, almost recovered from symptoms.

Case XXXIX.

S. A. M. 33 years.

Cough for four years gradually increasing sputum at first mucoid, then muco-purulent and occasionally foul. After 1½ years brick-colored sputum appeared occasionally and during past year is more frequent. In latter part of 1918 had frank hæmoptysis of two to four ounces, several times in a week, and again twice in 1919. Always rather delicate but at work steadily except during hæmoptysis.

March 12, 1919: Sputum about three ounces, frequently blood stained. No T.B. at any time. Has been diagnosed tubercle of lung. Physical examination of chest, negative.

X-ray shows dilated primary and secondary bronchi in both lower lobes.

Case XL.

M. F. 33 years.

Seen in consultation February, 1919, with influenzal pneumonia right lower lobe. In addition to the general involvement there were cavity signs about inferior angle of scapula with coarse consonating râles. Fingers clubbed.

As a child he had chronic cough and at about eighteen years of age was told he had a bronchiectatic cavity in right lower lobe, and that this symptoms might increase as he grew older. On the contrary, his symptoms gradually lessened and for some years he has been free from cough except for occasional bronchial colds.

Diagnosis.—Bronchiectasis with recovery from symptoms, the physical signs persisting.

The case histories give the bare outlines of onset, symptoms and physical findings. In some cases the original files were not available when the preparation of this paper was begun, and as a result a few are incomplete, being made up from short sketch notes. In all but Case XL, x-ray plates were made, and in two others neither the plates nor their readings were available for this paper. Thirty-seven roentgenograms have been studied and most of these were stereoscopic.

Age.—In the series the age incidence has been from 2½ to 40 years, seven were children, and thirty-three were adults, of whom 25 were soldiers.

Cough.—In two children, cough was present four and six months respectively and in three soldiers for six months. In seven other adults and one child was present under two years and in four others under three years, and in the remainder from three years upward, there being one record each of 15, 16, 17, 18 and 19 years cough.

Onset.—In twenty of the series the onset of the cough was associated with a bronchitis which became chronic. In seven the onset was dated back to a pleurisy, though in three of these there was an associated bronchitis. In seven pneumonia appears to have been the factor, and in these seven, one had many recurring attacks and was a complication of measles, and one of influenza. Three others are definitely traced to influenza and one to measles. Three are the result of enemy gas. In three the onset is not clear.

Clubbing of fingers was noted in 22. It was possibly present in more.

Hæmoptysis.—In twelve there was spitting of blood in quantity of a teaspoonful or more and in five of these the hæmoptysis was large.

Odor.—An unpleasant odor was present in the sputum of

only six. This is a minor point in diagnosis and if absent should not influence the clinician in his diagnosis. Stress is laid upon this symptom in the older text-books, but it is not to be looked for in a large proportion of cases where diagnosis is made early.

Amount of Sputum.—In children it is difficult to estimate quantity of sputum. In the adults it has usually been one to three ounces in twenty-four hours, in four the amount has been less than this and in two there was none—they had become symptom free though physical signs persisted. Three had four ounces, one six ounces and only one as much as ten ounces.

Physical Signs.—Physical signs which would localize the lesion were absent in seven cases, and in eight others were suggestive but insufficient to localize.

Previous Diagnosis.—This was usually chronic bronchitis, tubercle of lung, suspect tubercle of lung or clinical tuberculosis (T.B. not demonstrated). In two, dilatation was diagnosed and in two others mentioned as probable.

Tuberculin.—In thirteen of the fifteen civilian cases reported the intracutaneous test was applied. Of the thirteen four gave a slight reaction and nine did not react. Six of the children were tested and none reacted.

Nature of Processes.

Pulmonary abscess is a disease caused by microörganisms which produce acute infections. These organisms are often found in the air passages as is the case during epidemics of acute respiratory disease. Where the abscess follows operation on the upper respiratory tract the bacteria are probably dislodged in large numbers and aspirated directly into the trachea and bronchi. They are capable of ready implantation and rapid multiplication. They follow the direction of the strongest air currents with greatest ease, and usually produce their infection in the lower lobes. Less often they are found in the upper lobes. Blood metastasis must also be considered.

Bronchiectasis, being a disease of the bronchi in which dilata-

ERRATUM

Matter appearing on page 194, beginning

"Nature of Processes"

down to and including third paragraph on page 198 ending "*as noted in pulmonary tuberculosis*," was inserted in this place erroneously, and should be inserted after repeated attacks of bronchitis are common in bronchiectasis and in tuberculosis, but not in pulmonary abscess, page 203 of Dr. F. M. Pottenger's article.

tion and distortion occur as a result of pathological changes in their walls, often follows fibrosis and contraction of pulmonary tissue. It is commonly found near the hilus although the affection may involve the bronchi in all parts of the lung.

Pulmonary tuberculosis, being a chronic infection resulting from microörganisms which are not commonly found in the air passages, of those who are not suffering from tuberculosis, and which require time for multiplication, is not a disease which results immediately on the bacteria gaining access to the air passages. If the patient has not been previously infected, the bacilli, after entering the tissues, pass readily to and settle in the lymphatic glands and are later carried through the blood or lymph stream to be deposited in the capillaries or lymph spaces of the pulmonary tissue. This is the manner in which lung infection most probably takes place. While implantation of the microörganisms which produce the acute infections is favored by the relatively greater motion and greater force of the air currents in the lower lobes of the lung which force the bacteria deeper into the tissues, the relatively lessened motion of the apex favors implantation of the slowly developing, blood- and lymph-borne tubercle bacilli; consequently active tuberculosis with cavity formation is usually first found near the apices, while pulmonary abscess is usually found in the lower lobes; and bronchiectasis may be found in any portion, but often affecting the large bronchi near the hilus.

Inspection.

On careful inspection a diminution of motion will nearly always be noted on the side of the involvement in all of these affections; because they (1) all reduce the elasticity of the lung tissue, (2) cause a loss of tissue, and (3) produce a reflex diminuation of motion through the diaphragm and other muscles of respiration. In pulmonary tuberculosis this may be difficult to ascertain in those instances where there is a lesion in both lungs. In bronchiectasis, the lung involved is practically always con-

tracted and the mediastinum shifted toward that side. In pulmonary abscess contraction with shifting of the diaphragm may or may not take place, although it usually does if the process is a chronic one. The same is true of tuberculosis.

Reflex Changes in Muscles and Other Soft Tissues Determined by Inspection and Palpation.

The reflex spasm in the muscles and degeneration of the soft tissues—skin, subcutaneous tissue and muscles—is as a rule not as marked in pulmonary abscess and bronchiectasis as it is in pulmonary tuberculosis. The extent of the degeneration when the process has become chronic depends upon the extent and character of the previous inflammatory process. Pulmonary abscess is a focal infection in the lung. It may be single or multiple; but as a rule it appears as an acute disease in tissue which has not been, as is the case with tuberculosis, for a long time previously the seat of widespread foci of infection. Those abscesses which have followed our recent epidemics of acute respiratory infections, however, often occur near the base in the midst of areas of widespread fibrosis of pulmonary and pleural tissue. Bronchiectasis is, as a rule, limited in the amount of tissue involved. Like pulmonary abscess and unlike pulmonary tuberculosis it is rarely found in the midst of numerous active foci of infection. Pulmonary tuberculosis, on the other hand, when it becomes an active clinical process with cough, expectoration and cavity formation is nearly always a chronic disease, and the cavity is formed in tissue which, as a rule, is and usually has been for a long time, the seat of many foci of infection which have been undergoing all degrees of active inflammation. The result is that pulmonary tuberculosis offers the greatest opportunity for reflexes. The muscles of the shoulder girdle and diaphragm are more tense (increased tension in the latter is inferred from the limited motion) during the activity of the tuberculous process than in the other diseases. When the disease becomes chronic these muscles and the soft structures (skin and sub-

cutaneous tissue) in the neck and down to the second rib anteriorly and the spine of the scapula posteriorly, show far more reflex trophic changes in tuberculosis than in the other two diseases. *In fact, chronic tuberculosis of the lung may be suspected whenever the neck muscles and the subcutaneous tissue and skin of the neck and chest above the second rib anteriorly and the spine of the scapula posteriorly are markedly degenerated.* Pulmonary abscess and bronchiectasis also cause degeneration in these same tissues, but as a rule it is not so extensive; and I have seen instances of these affections which caused practically no reflex tropic changes.

Palpation and Percussion.

Percussion may give little or much information in abscess and bronchiectasis, but is of far more importance in pulmonary tuberculosis. Palpation has been of more aid to me than percussion.

Auscultation.

On auscultation the signs elicited in pulmonary tuberculosis with expectoration are usually more or less definite. If cavity is present in active tuberculosis it is found in the midst of actively diseased tissue, which usually gives rise to characteristic respiratory sounds and many râles; if chronic, the tuberculous process outside the cavity may be partly or wholly healed, under which circumstances the signs elicited on auscultation may be similar to those of pulmonary abscess. The signs of pulmonary abscess and bronchiectasis, as determined on auscultation are usually few and often very indefinite. *In fact, the nature of the process may be suspected from this fact—a definite history of cough and expectoration, usually, a fairly large quantity, sometimes even several ounces a day, and comparatively few signs of moisture on auscultation.*

Explanation of Different auscultatory Findings.

If the examiner only can form a true conception of why there are marked changes on auscultation in pulmonary tuber-

culosis; and why even with larger quantities of sputum, as is often the case, there is such an absence of changes on auscultation in pulmonary abscess, and bronchiectasis, then the differentiation of these affections will be easier. This I shall attempt to show graphically by the accompanying illustrations.

The explanation of this fact is based upon the difference in pathology as mentioned above when considering the reflexes which arise from these processes.

Mucous râles or crepitations may or may not be elicited over cavities depending on whether or not the mucus which they contain is disturbed by the ingress and egress of air. Rhonchi, are sometimes heard over them. *Conditions which favor the production of the most constant and greatest quantity of pulmonary râles are not found in the cavity itself but in the surrounding tissue as noted in pulmonary tuberculosis.*

Localization.—All were lower lobe or perhaps in some, middle lobe cases. Many showed some upper lobe involvement. Last year I reported one upper lobe case but none have been met with in this series with the lesion principally in the upper lobe.

Conclusions.—Bronchiectasis is not a rare condition and will be frequently met with in a special chest clinic. It is to be differentiated in its early stages from bronchitis and tubercle of the lung, in its advanced stages from pulmonary abscess and tuberculous cavity.

Hemorrhage is frequent and may be slight or severe.

Repeated examinations of the sputum for tubercle bacilli must be undertaken. Given purulent sputum which on a series of examinations shows no acid fast bacilli, the diagnosis of tubercle of lung is not justifiable until other chronic respiratory diseases have been excluded.

Clubbing of the fingers and toes is a very suggestive symptom.

In differential diagnosis a careful clinical history and a study of the symptoms and physical signs will usually determine opinion but the stereo-roentgenogram is invaluable.

Nutrition has been good in most of the cases and is of some assistance in differentiating from tuberculosis.

X-ray Findings.—The single plate is of value only in the diagnosis of dilatations of the main bronchi or their primary divisions, and is not always satisfactory here. For dilatation of the smaller divisions or in the presence of much peribronchial infiltration and pulmonary fibrosis the stereoroentgenogram is necessary. It is an invaluable aid in diagnosis.

POINTS OF DIFFERENTIAL DIAGNOSTIC VALUE IN PULMONARY ABSCESS, BRONCHIECTASIS AND PULMONARY TUBERCULOSIS,

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With an Explanation of the Cause of the Difference in Auscultatory Findings.

Pulmonary abscess, bronchiectasis and pulmonary tuberculosis are very often wrongly diagnosed. Unless one has had considerable opportunity to examine patients suffering from each of these diseases he is apt to experience considerable difficulty in differentiating them. If, however, a careful study of the disease and the manner in which it affects the patients is made, the differentiation will not be so difficult. Both pulmonary abscess and bronchiectasis are often diagnosed as tuberculosis on the basis of cough and expectoration. The fact that bacilli are not found is no longer sufficient to prove the non-tuberculous nature of a pulmonary process; consequently this fact confuses more than it helps In my own work I have had opportunity to study numbers of patients who were expectorating quite large quantities of sputum. Some of these have been of a tuberculous nature, yet bacilli have been found only at rare intervals. In other patients, who had had a definite tuberculous process which had been accompanied by cavity formation and sputum containing bacilli, the general process healed leaving a secreting cavity with a considerable amount of expectoration in which tubercle bacilli were not found, even after repeated examination. So, while the presence of tubercle bacilli shows the definite tuberculous nature of sputum, their absence does not prove the process to be non-tuberculous.

Clinical History

Pulmonary abscess usually follows acute infection of the lung, in which such organisms as streptococci, staphylococci or the pneumococci are the etiological factors, such as have been common during the epidemics in both army and civil life during the past two years. It also follows operations on the teeth, tonsils and nasal cavities now and then, the infectious material being aspirated or passing through the blood stream is carried into the lungs where it becomes implanted and is followed, from a few days to a week or two later, by an acute abscess. I am led to believe that abscesses having this etiology are more common after tonsil operation than is generally believed. I have seen more than twenty during the past year and a half; and other observers as Manges[1] and Richardson[2] report cases which have come under their observation. When chronic and sometimes even when acute they are mistaken for pulmonary tuberculosis. These however always furnish a history of acute onset; expectoration, sometimes foul smelling, usually profuse at first, varying in quantity later; quite often periodical rises of temperature; and sometimes bloody expectoration. Clubbing of the fingers usually comes on quickly. I have seen it very pronounced in abscess following tonsillectomy in less than three months after the abscess formation; and have noted it as early as six weeks.

The most common form of pulmonary abscess that clinicians deal with today is that which followed the recent influenza epidemic. The abscess is usually found in the lower half of the lung and is often situated in fibrous tissue which has resulted from the infection. Not uncommonly a complicating pleurisy was present which has resulted in pleural adhesions and thickening. Prior to the recent epidemic the type of abscess which was most common in my practice was the one following operations on the upper respiratory tract. It was only occasionally that I saw one following an acute respiratory infection.

Bronchiectasis, as I have observed it, usually follows a pneumonia in childhood, although I have seen it follow the same

in a few instances in adolescence and early adult life. It sometimes begins with a bronchitis and persists as a chronic form of this affection. Bronchiectasis will undoubtedly be common after our recent epidemic of influenza. I have rarely seen it begin in those past middle life, unless it was of a tuberculous nature. The patient usually gives a history of cough which continued after a pneumonia or after a bronchitis as before mentioned. Oftentimes cough with expectoration has persisted since the pneumonia; at other times it has appeared only when the patient had what was termed a "cold." If the process follows chronic bronchitis it also shows periods of exacerbation. Temperature may be present occasionally, and the sputum is at times bloody. The cough in most of my cases has been loose, indicating that the sputum is in the larger tubes where it is easily moved. *The loose nature of this cough itself has proved of diagnostic worth.* A history of cough with expectoration, following, and persisting after a pneumonia in childhood is of itself nearly sufficient for the diagnosis of the post-pneumonic type. The fingers are often clubbed, but in my experience this sign is not as important as in pulmonary abscess. It is neither as constant nor does it appear as quickly.

Pulmonary tuberculosis with cavity gives a very different history. As a rule the patient forms an abscess cavity of a tuberculous nature only after the disease has existed as a clinical entity for some time; although now and then we see a sudden onset with cavity following in a short time. Occasionally a mistaken diagnosis is made and the acute signs in the lung at the time of the formation of the cavity are taken for pneumonia. A careful study of the clinical history will often aid in differentiating these processes. Cavity formation in tuberculosis is more apt to be preceded by repeated attacks of toxemia sometimes months apart, while pulmonary abscess usually comes on promptly following an acute infection in a patient who was previously in good health. I have seen a few cases of tuberculous abscess form in which the patient had complained of acute ill-

ness for only a short time. The patient with tuberculosis as compared with the one suffering from pulmonary abscess or bronchiectasis is more apt to suffer from nerve irritability, and as a rule shows a greater degree of nutritional disturbance when the acute process comes on. Repeated attacks of bronchitis

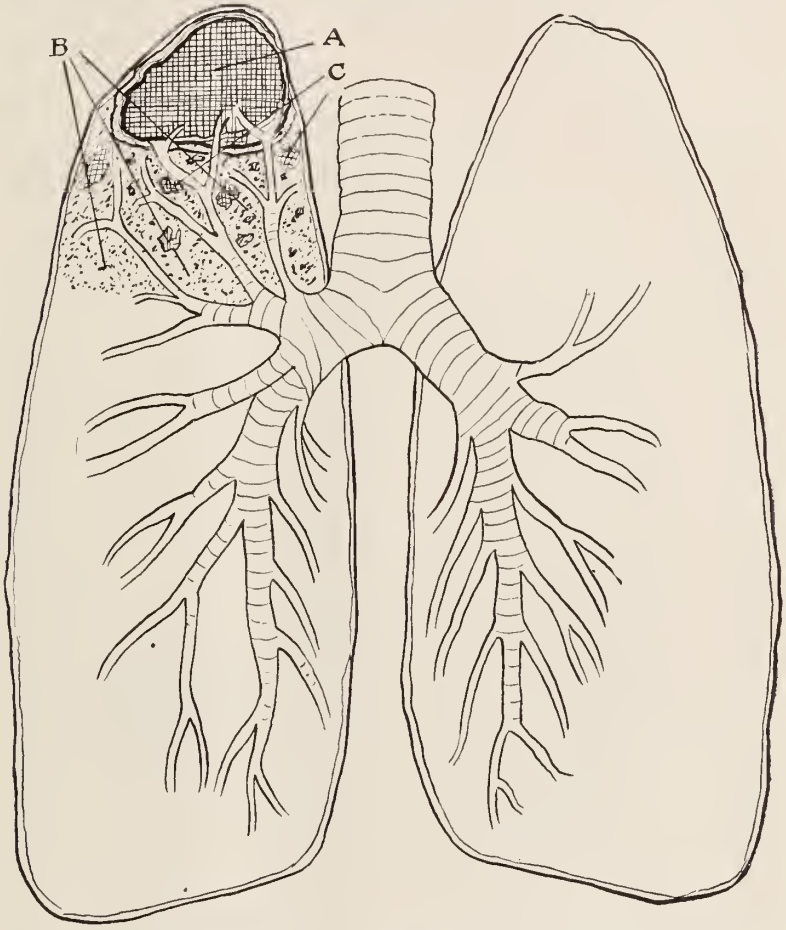

FIG. 1. Diagrammatic illustration of a cavity due to pulmonary tuberculosis. The cavity *A* is surrounded by tissue which is the seat of tuberculosis infiltration *B* and which contains many small cavities *C*. These are ideal conditions for the production of rales.

are common in bronchiectasis and in tuberculosis, but not in pulmonary abscess.

The relative prominence of râles in these three affectionsmay be illustrated by the accompanying figures. Fig. 1 illustrates the conditions present in pulmonary tuberculosis. A large cavity *A* has formed near the apex. It will be noticed that this

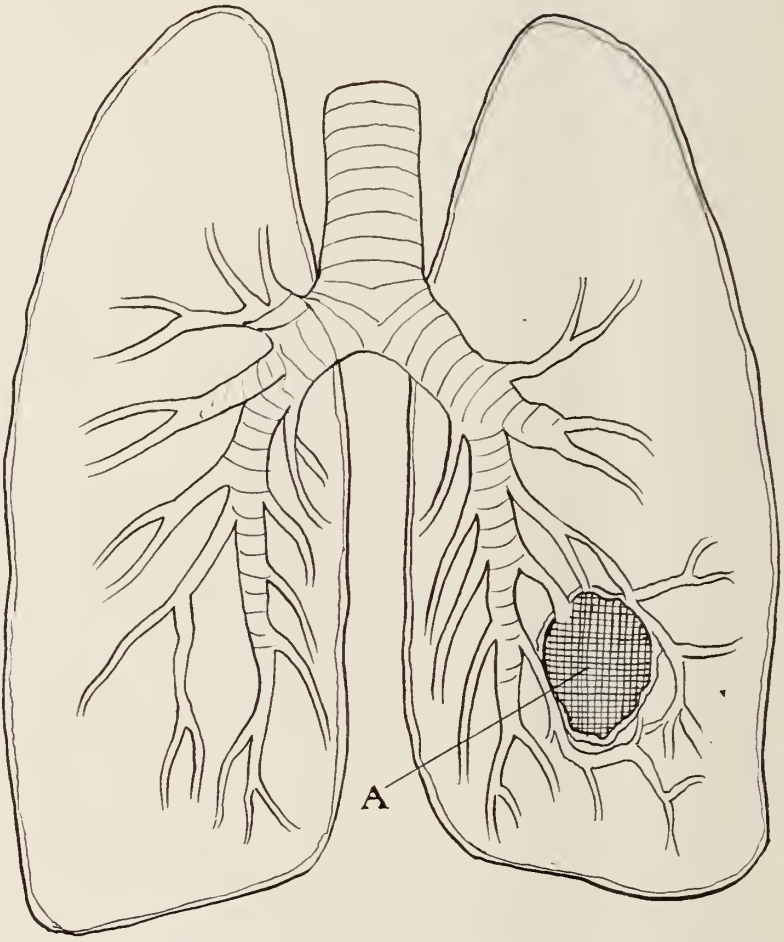

FIG. 2. Diagrammatic illustration of acute pulmonary abscess. Abscess *A* is situated in the midst of and surrounded by healthy pulmonary tissue. The source of rales is the cavity itself and the bronchi leading from it. This condition is not favorable to the production of many rales.

has taken place in an area which is the seat of a widespread tuberculous involvement as illustrated by the dotted area *B*, throughout which there are numerous small cavities, *C*. Here we have the ideal conditions for the production of crepitations and mucous râles; inflammation with foci of necrosis involving the walls of air cells and bronchi accompanied by an increased production of mucus which must find its way toward the trachea, through bronchi of all sizes. The cavity itself is at times the seat of coarse râles; at other times no râles are elicited over it. Not infrequently, I have seen the sudden disappearance of râles take place over an area of tuberculous infiltration as a result of cavity formation.

Fig. 2 illustrates the condition present in pulmonary abscess. An abscess *A* has formed as a result of acute bacterial infection. As a rule the first pulmonary abscess which forms is an acute process coming on within a few days after the implantation of bacteria has occurred. The surrounding tissues may not be at all infected. This is particularly characteristic of those abscesses which follow operative procedure upon the upper respiratory tract. The abscess often forms in a single focus the same as a boil forms on the surface of the body. When the pressure in the abscess becomes sufficiently great rupture occurs at the point of least resistance which is usually into a bronchus.

A pocket which forms pus remains and discharges it through the bronchus. The conditions in the surrounding tissues which favor the production of crepitations and râles as shown in pulmonary tuberculosis in Fig. 1, are absent and the chief source of whatever râles may be present is the abscess cavity itself and the bronchus or bronchi which drain it. The result is that crepitations and mucous râles are few in abscess produced by acute infections as compared with the abscess cavities which accompany pulmonary tuberculosis, unless the latter have existed for a long time and the tuberculous involvement of the surrounding tissue has healed.

When multiple abscesses form in non-tuberculous lesions as they sometimes do, particularly in those cases which become

chronic, each one repeats the same cycle of events as noted in the acute single abscess. Varying amounts of scar tissue result; but still the widespread inflammatory and destructive processes which caracterize tuberculosis and which favor so greatly the production of crepitations or mucous râles, is absent. If the infectious process in either pulmonary tuberculosis or

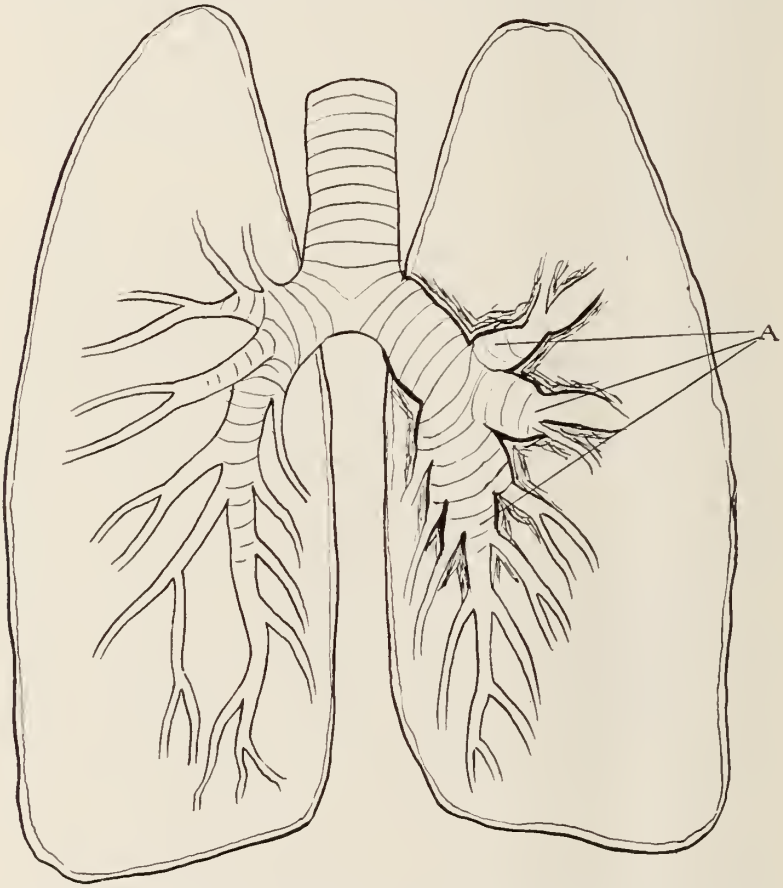

FIG. 3. Diagrammatic illustration of bronchiectasis. The bronchiectatic dilatations *A* are surrounded by pulmonary tissue which is not the seat of infection; consequently the main source of rales is the mucus which forms in the dilated bronchi. This condition is not favorable to the production of many rales.

pulmonary abscess involves the pleura then crepitations may be present which may be differentiated from pulmonary râles only with the greatest difficulty and sometimes not at all. In cases of bronchiectasis involving the finer bronchi râles are more common than when the larger ones alone are involved.

Much the same condition is found in bronchiectasis as far as the production of râles is concerned as has just been described in pulmonary abscess. The bronchi are dilated and their walls thickened as shown in Fig. 3, *A*, in such a manner that the dilatations have much the same physical appearance as abscess cavities. The surrounding tissue is thickened, fibrous in nature, and offers little opportunity for the production of crepitations and mucous râles, except the finer bronchi be involved. At time there is constriction of the bronchi proximal to the dilatation which may favor accummulation of secretion and cause sounds on auscultation; but there are rarely heard on auscultation either in abscess or in bronchiectasis sounds which will afford any idea at all of the extent or seriousness of the pathological process present.

A history of persistent expectoration of moderate or large quantities of sputum, with a diminished respiratory excursion on one side of the chest, and an abscence or paucity of crepitations or mucous râles on auscultation over the side affected should make one think of pulmonary abscess or bronchiectasis. Rhonchi are often present, but they too may be absent.

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DISCUSSION.

Colonel Bushnell: I have noticed that it is frequently reported with reference to case of abscess of the lung that the percussion note is very dull or practically flat over the abscess. This suggests that the abscess occupies a superficial position as respects the lung, is subpleural. I have in mind a case of abscess following pneumonia in 1891. It was the year after the earlier epidemic of influenza which

prevailed in the West in 1890. We had many pneumonias in 1890 and 1891, and in the latter year I saw two cases of lung abscess as sequels to pneumonia. In the case to which I especially invite attention the abcess was very large. I calculated after several aspirations that its capacity must have been at one time about 90 oz. It was so extensive and so closely in apposition to the chest wall that it was supposed to be an empyema and an attempt was made surgically to drain the pleural cavity. But instead of the expected flow of pus we found that we had produced a pneumothorax. Looking through the wound the lung could be seen collapsed against the spine, but not retracted upward on account of the weight of the abscess, so that the lung had the shape of a sausage. No harm was done the patient. The pneumothorax soon disappeared and after a time the abscess ruptured into a bronchus and he made a good recovery, served in the army some years and has only recently died from another cause. The interesting feature to me in this case is that this large abscess did not rupture though one wall consisted of little but pleura and that wall was for a time unsupported on account of the pneumothorax. Another point is the fact that for a long time there was no communication with the bronchial tree. These facts show that the abscess was not under tension and that its seat was in the connective tissue frame work of the lung. It was in short a sequel to what was once called dissecting pneumonia. The acccount of the post mortem appearances given by Stokes in his "Diseases of the Chest" nearly a century ago is still the best one.

Dr. T. A. Claytor: While there is no one who is more interested in the finer points of physical diagnosis than I am, I feel sure that a positive diagnosis between tubercular cavity, bronchi ectasis and abscess of the lung can be made much more confidently with the aid of the x-ray than by the ordinary means of physical examination employed alone.

In this connection I would like to mention a case of lung abscess following pneumonia which recently came under my care. A young man was admitted to the Garfield Hospital with a high fever and complaining of pain in the abdomen. He was at first sent to the surgical side, but I saw him the same day making a diagnosis of diaphragmatic pleurisy largely through the reference of pain to the region of the trapezius muscle as well as to the abdomen on the same side. Pneumonia developed and later suspecting pus in the chest, a hypodermic puncture in the lower left axillary region confirmed the suspicion. No x-ray picture was taken and the case was thought to be one of empyema and was referred to the surgeon. Unfortunately I could not be present at the operation. An incision between the lower ribs showed no pus in the pleural cavity, and the man was returned to the ward. He sank rapidly and at autopsy an abscess was found in the extreme lower portion of the left lung. The moral to be drawn

is that the man who has diagnosed the presence of pus should always be at the operating table to urge a careful search for what he knows to be there.

Dr. Pottenger: Closing discussion on his own paper.

I appreciate the discussions which my paper has called forth. I will say with reference to the point made by Dr. Elliott that I can conceive of a very slight case of bronchiectasis which would not produce any particular change in the motion of the chest wall, but any pathological process of this nature of sufficient magnitude to produce repeated clinical manifestations would in all probability show some limitation of motion, at least this has been my experience in those cases which have come to me for examination. The clinical history is of great diagnostic importance.

Referring to Dr. Claytor's suggestion that it is unnecessary to endeavor to make diagnosis by physical examination because the x-ray will show bronchiectasis so readily, I beg to state that no impersonal method of examination should ever be permitted to take the place of personal examination. One of the great difficulties in modern medicine is that by relying on laboratory methods and the x-ray, physical examination has lagged behind. No one thing has done more harm to physical examination of the chest than the x-ray; on the contrary it should have aided it. Medical men have become lazy and have attempted to have diagnoses made for them. But I wish to insist that a careful physical examination of the chest is the most important examination that can be made and that if men will train themselves in close observation they will be able to give an opinion of far greater value than that given by instrumental or laboratory methods.

Regarding the treatment of pulmonary abscess and bronchiectasis, the same hygienic measures should be used in treating them as are used in the treatment of tuberculosis. I have, however, added to them the use of iodine and vaccines. I have had considerable experience in the use of vaccines and feel that they have at times aided. I use iodine over a prolonged period of time. I give the tincture three to thirty drops three times a day, or the syrup of hydriodic acid. By these measures I have seen a number of cases of bronchiectasis improve, some lose their secretion, and I have seen some cases of severe abscess cease discharging. While these cases are serious and offer comparatively little hope, yet by persistence one may help many of them.

FIELD OBSERVATIONS ON BLOOD VOLUME IN WOUND HEMORRHAGE AND SHOCK.

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The value of transfusion and infusion in hemorrhage, which had already been established before the war, received abundance of confirmation during the war. Nevertheless, during most of the war little progress was made beyond the outstanding fact that either transfusion or infusion was a life-saving procedure in certain cases. In other cases neither of these procedures seemed to be of particular benefit. There grew up the advocates of transfusion on one hand and of the infusion of blood substitutes on the other. In each instance conclusions were drawn from clinical results.

It was obviously desirable to establish criteria; in the first place to determine the therapeutic application of either or both of these procedures, and in the second case in order to evaluate properly these methods. While there may be many other factors involved in the transfer of blood or of blood substitutes to the patient, there are two fundamental considerations which must be granted. It must be obvious that by transfusion one transfers a certain volume of fluid, and one also transfers a certain amount of oxygen-carrying substance. By infusion one merely increases the blood volume of the patient.

Robertson and Bock[1] utilizing the method of Keith, Rowntree and Geraghty[2] studied the blood volume in certain cases of wound hemorrhage. They found that with the estimation of the blood volume and of the total hemoglobin one was able to construct rather more definitely than had been done before

indications for the use of transfusion or infusion, or both. The method which they used was obviously not entirely suitable for work under the usual conditions in the field. It is apparent that if one estimates any of the ordinary constituents of the blood and then dilutes the blood with a known amount of fluid which does not contain that constituent, it is possible to derive a formula by which, more or less roughly, the blood volume can be calculated. After consideration of the various possible methods it seemed most feasible to utilize hemoglobin determination. In the first place it was necessary to estimate the hemoglobin by some reasonably accurate method in order to acquire part of the necessary data. In the second place it was felt that the hemoglobin determination could be made quickly, with very little apparatus and fairly accurately. The method of determining the hemoglobin was what might be called a home-made modification of Sahli's method. Using the well-known principle of that method a goodly number of hemoglobinometers could be constructed anywhere if one had small test tubes and decinormal hydrochloric acid. Arbitrarily an assumed normal blood or better pooled normal bloods were taken as standard, 100 per cent. Previous experience had indicated that this method was fairly satisfactory and that when read in the daylight different observers constantly read within two points. Furthermore, since the comparative readings were in general made within a few moments and with the same apparatus the general errors were minimized. The actual procedure was as follows; The hemoglobin was estimated from the ear or preferrably from the arm vein, then 500 c.c. or other fixed amounts of either normal or saline or of gum acacia in normal saline were given intravenously. As soon as possible after the infusion the homoglobin was again estimated in the same way as before. From these estimations one then deduced the blood volume. For example, a patient's hemoglobin was 80 per cent. before the introduction of 500 c.c. caused a 10 per cent. drop. Therefore 10:80 : : 500: x or the blood volume, which is 4,000 c.c. after the infusion or

3,500 c.c. before the infusion. It was necessary to assume that the normal blood volume ranged between 5,000 and 6,000 c.c., depending upon the size of the individual. One compared the blood volume actually obtained with the presumed normal for that individual. From this one also estimated the absolute hemoglobin in terms of per cent. From these data it was possible to determine in the first instance if the patient needed any increase in blood volume, and furthermore if he needed any increase in the oxygen-carrying constituent.

The observations upon which this paper is based were made in field hospitals and evacuation hospitals in the A.E.F. Most of these hospitals had wards designated as "shock wards," to which patients in so-called shock were sent. In practice it worked out that most of the very seriously wounded cases were sent to this ward. The presenting problem was to get the patient in shape for transportation or for operation. Naturally some of the cases were past-operative. Most of the patients were studied within twenty-four hours of injury. Owing to the conditions it was never possible to keep patients more than a few days for continued observation.

In all cases careful and repeated blood pressure readings were made and in general the blood pressure reading was taken to represent the condition of the patient with full regard for all of the varying factors hemorrhage, shock and infection. In this work no attempt was made to study the important factor of blood flow. The importance of blood flow was, of course, recognized, irrespective of the question of how much blood flow depends upon blood volume.

In general it was found that in order to furnish a reasonable basis for recovery patients should have at least sixty-five per cent. of their blood volume and at least twenty-five per cent. of their total hemoglobin. Owing to the nature of this work it was obviously impossible to check up very definitely exactly at what point of either blood volume or total hemoglobin the positive indications for transfusion or infusion came. It is

evident that each case created a special problem because no two cases were alike. In some cases there was a great increase in the element of infection; in some cases there was the necessity of providing against an operation of more or less severity, which certainly would augment the element of shock. Furthermore, the element of shock was always a variable and undeterminable factor. It was the experience early in the work that hemorrhage and shock were very closely associated and accumulated experience was unable to separate clearly in my mind the manifestations which could be attributed to shock. Consequently it was our custom in field and evacuation hospitals to regard wounded cases in a serious condition as suffering from hemorrhage and shock. In the paper I have continued this somewhat reprehensible practice. As far as I know we studied no cases of shock without hemorrhage.

Our results show that seriously wounded men, even without the history of hemorrhage, usually had lost a considerable amount of blood and blood volume. Theoretically at least, the percentage of total hemoglobin when subtracted from 100, gives the percentage of blood loss. For example, a man presents a blood volume of 4,500 c.c. against his estimated normal of 6,000 c.c., or 75 per cent. His relative hemoglobin is 80 per cent. His actual total hemoglobin is 60 per cent. Presumably he has lost 40 per cent. of his blood or 2,400 c.c. However, he has replaced by fluid either from his tissues or his fluid intake or both 900 c.c. as his blood volume deficiency is only 1,500 c.c. We assume that it is the 900 c.c. of fluid addition to his depleted blood volume which has diluted his hemoglobin from 100 to 80 per cent. Of course this argument presupposed that the man originally had both a normal blood volume and normal hemoglobin. In general the evidence indicates that these presuppositions are reasonably sound.

In some instances these losses represented well over half the total amount of blood. In those cases we early came to recognize a very important fact. If the blood volume was not

being restored at least to an appreciable extent the prognosis was very grave, irrespective of treatment. In other words, when natural forces tended to restore in its normal fashion the blood volume the prognosis was relatively good. We came to recognize the fact that contrary to the usual offhand snap judgment, but strictly in accord with logical reasoning, if a patient presented himself at the end of twenty-four hours or more with a relatively low hemoglobin, say of 60 to 80 per cent., that patient was in much better condition than one who presented himself with a hemoglobin of over 100 per cent., or the well-known phenomenon of blood concentration in shock. In the most severe cases we found an astonishingly low blood volume, sometimes under 30 per cent. of normal, and an absolute hemoglobin of under 20 per cent. It may be repeated parenthetically here that in such cases the relative hemoglobin might be normal. Such cases in our experience, unless due to very recent large hemorrhage, and unless immediately corrected by large transfusions, were fatal. It became clear that as had been observed clinically there was a considerable group of cases of hemorrhage and shock in which on account of the severity of the condition little could be expected of any remedial measures. Another not inconsiderable group was made up of those cases who had no tremendous blood loss but who had a blood volume ranging around 60 per cent. In those cases the execution of the obvious indication of partially restoring the blood volume by infusion was followed by elevation of the blood pressure and of the apparent restoration of the patient to a condition of relative well being.

Perhaps the most interesting group of patients was the intermediate group between the two above groups. In this group the indication was for both the restoration of blood volume and of the oxygen-carrying constituent. In some of these cases simple transfusion was enough. Other cases required both transfusion and infusion. In some cases within a relatively short time over 1,000 c.c. of blood, and in addition over 1,000 c.c. of fluid, were administered.

Inasmuch as Robertson and Bock had previously suggested that fluids administered by the alimentary canal were taken up and retained, provided the concentration of hemoglobin was adequate, fluids were administered both by mouth and by rectum whenever possible. Furthermore, although it was fully appreciated that salt solution under the skin was, like salt solution into the veins, only temporarily held in the circulation nevertheless both of these methods were utilized to meet the temporary emergency.

It is worthy of repetition that the continued administration of fluids in goodly amounts (usually by mouth) is necessary in practically all cases requiring transfusion. Transfusion may put them by the danger point in regard to both blood-volume and oxygen-carrying constituent, but there remains as a rule a considerable blood volume deficit which it is desirable to make up as rapidly as possible. All of the cases were controlled as far as possible in regard to the progress of the maintenance of an adequate blood volume by repeated hemoglobin estimations. It must be obvious that a blood which is steadily diluting, that is to say, with a steadily falling hemoglobin reading, is steadily increasing its blood volume.

In the connection of prognosis, which may have some possible relation to the factor of shock, a considerable series of cases seemed to demonstrate the following hypothesis: In case the blood volume as determined by these rough methods was maintained in a satisfactory level, the prognosis tended generally to be good. However, in those cases in which the blood volume could not be maintained, and despite all methods of fluid administration the blood tended to reconcentrate the prognosis was bad. Cases were observed in which the tendency of reconcentration was persistent despite therapy and in which a grave prognosis could be given on account of this tendency to reconcentration, even while the blood pressure was at a satisfactory level.

Simple observation of these patients showed that as a rule

they had a loose skin, which in itself tended to be dry, although the surface of the skin might be covered with perspiration. It seems logical to assume that the relatively unknown factor of tissue fluids plays a considerable part in the restoration of blood volume and that the tissue fluids are presumably called upon and relatively exhausted fairly early in this condition. This assumption and the evidence gathered in the study of blood volume indicates that it may well be highly desirable to encourage the ingestion of fluid in all cases liable to alteration in blood volume. It is of course well known that soldiers in actual conflict not only lose a great deal of fluid by perspiration, etc., but also that they have frequently a diminished fluid intake for a considerable period before their injuries. Furthermore, actual experience shows that in the interval between injury and the arrival in a field hospital there is often not only loss of blood but also loss of fluid by perspiration and a continuation of the inadequate intake of fluid. In dealing with deficiencies in blood volume it must be remembered that such deficiencies irrespective of tissue fluids, which may be regarded as a reserve, may amount to 3,000 c.c. The administration of sips of water during the transportation of the patient is of course inadequate. In one sector it was possible to adopt a system of liberal administrations of fluids at several stopping places during the period of transportation. Observations on patients from that sector, while obviously susceptible to misinterpretation, nevertheless seemed to show definitely less tendency to the severe condition of associated wound shock and hemorrhage and the hemoglobin estimation showed fairly constantly a satisfactory and favorable hemoglobin dilution. It is believed that the recognition of the importance of the disturbance of blood volume in the creation of the associated symptom complex of wound hemorrhage and shock will lead to important preventive measures such as the insistence on a liberal intake of fluid by all methods during the times of the possible acquisition of wounds and immediately after wounds. Furthermore, in the treatment of all cases of war wounds in-

sistence ought to be laid upon the liberal intake of fluids. Since Robertson and Bock have found in their cases studied often several days or several weeks after wounds that the blood volume was frequently lowered, the insistence upon the liberal intake of fluid should be continued throughout convalescence. It is also common knowledge that external warmth is beneficial to cases of exhaustion, prostration and shock. It would seem to be of great importance in view of these studies to avoid very carefully any considerable amount of sweating in the application of external heat in order not to run the risk of reducing further the blood volume. Experience shows that this consideration is often overlooked.

Summary.

The observations reported here would seem to indicate the importance of blood volume in wound hemorrhage and shock. Profound disturbances of blood volume are always serious and if maintained for any considerable period are usually associated with death. It seems evident that the human mechanism can tolerate greater changes in the oxygen-carrying constituent, that is,—the hemoglobin, than in the blood volume. This coincides with the well-known clinical observation that the result of hemorrhage results at first in a lowered hemoglobin, or in other words that blood volume is restored at the expense of dilution of the hemoglobin. Blood volume can be easily and roughly estimated by comparative readings of the hemoglobin per cent. before and after the intravenous infusion of a known amount of fluid. A knowledge of the blood volume gives adequate data for the establishment of rational therapy.

The milder cases of wound hemorrhage and shock require only an increase in blood volume. The severer cases require both an increase in blood volume and an increase in oxygen-carrying constituent. This double requirement is met in part by transfusion. However when transfusion is indicated it is usually desirable still further to increase the blood volume which may be accomplished in various ways.

The continued observations on blood volume give furthermore valuable information as to prognosis. A general study of blood volume strongly suggests certain procedures which may be utilized for the prevention and control of the associated sympton complex known as wound hemorrhage and shock. There is reason to believe that the general observations have an application beyond the special field in which they were made. That the blood volume may be seriously disturbed with its attendant indications for therapy in various conditions which tend to derange the usual careful adjustment between fluid intake and outgo is certainly suggested.

I desire to record my appreciation of the work of Captain Baird, Captain Ohler, and other officers of the Medical Corps of the A.E.F., who actually made many of the observations which are summarized here.

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CLIMATE AND ITS RELATION TO ACUTE RESPIRATORY CONDITIONS.

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Following the last two years, during which time we have experienced a remarkable prevalence of acute respiratory diseases not previously met and studied to such an extent by this generation of observers and in reviewing many reports from all parts of the world, we frequently note reference as to the causation of epidemic bronchitis, influenza and pneumonia and their relation to certain meteorological conditions which, if not held responsible for them, are indicated as having a great influence upon the spread or the sudden termination of these diseases. As these references are made by the most serious writers, it seems necessary for us as climatologists to carefully study every meteorological condition that may have any bearing on such a formidable disease as influenza and pneumonia.

What were the unusual weather conditions, if any, prevailing to account for this most serious bacterial attack upon the human race? For instance, a medical writer in Spain states: "After the subsidence of the epidemic of influenza in Spain last spring, the summer was extremely dry, the drouth being worse than even the oldest inhabitants could remember, and the epidemic flared up again in a much severer form, and the disease, which first seemed to yield to the extreme hot weather, suddenly spread throughout the whole of Spain."

Another writer from the Philippines states that: "The disease ravaged in the islands for about six weeks, when a typhoon with torrential rain followed by strong winds swept away the last vestige of the disease."

Baccarini is inclined to believe " that the germs causing it had

their virulence suddenly enhanced by some mysterious influence, electric, atmospheric, or telluric." Another writer states: "The epidemic appeared after a very hot season had suddenly been succeeded by a very cold one and that perhaps the weather precipitated a large amount of other respiratory infections such as always become prevalent at this season (autumn)." This is answered by many other writers who state that this pandemic differs from that of 1890 and 1892 in that acute nasal catarrh and sinus involvement were conspicuous by their absence this year. It is also said that among the causes which contributed to the high incidence of influenza-pneumonia in the American Expeditionary Forces was due to soldiers working and sleeping in wet clothing and shoes, eating of food served cold, insufficient blankets for warm sleeping during the wet, cold period in northern France, yet several exhaustive reports of the incidence of influenza-pneumonia among troops stationed in barracks and tents in this country show the that weather conditions when the epidemic struck, were unsurpassed; no rain, not coudy, fair and warm—the weather being all that one could wish for the troops occupying tents, and that a long period of fine weather followed the onset of the pandemic. In letters sent out by a medical association for the prevention of disease, a slip was enclosed which reads: "Spanish influenza is undoubtedly due to lack of sunshine and fresh air, to dampness out doors and in and to getting wet feet." This is not quite as amusing as a special telegram to one of the leading Philadelphia papers dated Boston, October 7, which reads thus: "In connection with the influenza epidemic the directors of the 'Mother' Christian Science Church here announce that the mind is a source of contagion and that elements can contaminate only as diseased images held before the thought and paraded before an excited imagination preliminary to having them expressed on the body through fear and apprehension." Another writer states: "The numerous gases used on the battlefields of Europe with their highly poisonous properties, the liberation of large quantities of ground air high in carbon

dioxide content due to trench digging and shell holes, the gases from decomposing bodies of men and lower animals, and those set free by the destruction of cities and munition dumps during the last four years may have combined to form a gaseous compound with highly toxic properties probably due to rearrangement of molecules by the tremendous concussion produced by high explosives." With this idea in mind he states: "I am going to advance the theory that the condition termed influenza is in reality a non-bacterial, non-contagious disease caused by the inhalation of small amounts of depressing, highly irritating high density gas present in the atmosphere, especially at night when the air is surcharged with moisture, more particularly near the surface of the earth." He also states: "The mode of transmission is undoubtedly through the agency of the atmosphere."

The idea that some atmospheric influenza or free-from-germ explanation of infections and epidemics was promulgated by Wagner many years ago in his work on pathology under the title of "The Epidemic Constitution of Disease."

Dr. Onodera, of the Society of Internal Medicine of Japan, has laid stress on the meteorologic relation of the occurrence of influenza epidemics, the latter running parallel with the severe cold that returns at about thirty-year intervals. There may possibly be some relation of extreme cold periods and crowding.

To get an idea of what happened during the nine weeks' period from September 2 to November 9 in a meteorological study we have made a chart of the mean daily temperature for September, October and November, 1918, and also for these months for the last ten years, and have compared them with the same months for the years 1890–91. We also have made a daily chart covering the same period for precipitation, humidity, sunshine, cloudiness, wind velocity and wind direction. As a rule the epidemic began and reached its height in the eastern portion of the country in the same manner as it did in 1890.

A New England weather station was taken for observations because, like the epidemic in 1890, it commenced in New England

Monthly Mean Temperature.

	1890.	1891.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.
September	62.9	66.4	65.5	62.8	64.5	64.2	64.1	62.6	64.4	68.1	64.2	61.1	61.0
October	51.3	50.7	56.2	51.5	55.8	53.2	56.7	57.7	57.1	55.5	55.3	50.7	56.0
November	41.7	40.9	42.9	46.1	40.7	40.8	44.8	45.4	42.5	44.6	43.2	39.4	44.4

Total Monthly Precipitation.

September	5.38	3.96	0.88	3.93	1.83	2.33	2.32	2.52	0.17	1.35	2.54	2.23	6.16
October	7.63	4.62	1.58	1.76	1.15	7.44	1.22	10.64	3.81	3.30	2.05	4.68	1.20
November	0.67	2.21	0.83	1.51	4.56	6.40	3.37	2.74	3.28	1.90	2.54	1.08	3.37

Monthly Mean Sunshine.

September	52	71	62	57	60	62	50	62	80	70	73	70	59
October	42	58	60	66	68	54	63	39	55	56	72	57	55
November	65	52	48	49	53	54	57	49	57	52	63	68	53

Monthly Mean Wind Velocity.

September	5.5	6.3	7.3	8.9	7.6	8.9	7.5	8.0	8.1	8.4	9.1	7.8	8.7
October	6.8	8.7	8.7	8.6	9.8	9.0	8.1	8.8	7.9	8.8	9.5	10.4	8.2
November	7.2	9.7	8.8	10.5	9.9	10.0	9.7	8.8	10.5	9.6	8.8	9.3	8.9

Monthly Mean Prevailing Wind Direction.

September	NW	SW	N	N	N	N	N	N	N	NW	S	N	N
October	NE	N	N	W	NW	N	N	N	S	S	N	N	S
November	NW	N	N	W	NW	W	SW	N	N	SW	SW	NW	NE

Monthly Mean Cloudiness.

September	4.8	2.9	4.0	4.9	4.7	4.6	6.0	5.3	3.3	4.2	3.7	4.7	5.1
October	5.8	4.2	4.3	4.0	4.1	5.3	4.7	6.7	5.2	5.1	3.8	5.2	5.1
November	3.5	4.8	5.3	5.7	5.4	5.4	5.2	5.8	4.8	5.2	4.3	3.8	5.1

Monthly Mean Humidity.

September	85.3	61.6	73.0	76.8	77.2	74.8	77.6	76.0	65.8	77.6	73.4	70.0	75.6
October	80.4	77.7	73.0	76.8	68.2	75.0	71.4	77.8	72.0	83.4	75.4	74.4	76.6
November	76.0	74.0	71.8	68.3	71.0	67.8	68.4	68.3	65.0	68.1	76.4	61.0	70.2

and spread westward in a fan-shaped manner. As will be noted by the chart, the precipitation for the first 18 days of September was nearly 5 inches. This is a very unusual rainfall. In September of 1890 it is noted that the precipitation was also over 5 inches. The only bearing it has on acute respiratory conditions is the tendency to drive people inside and to cause crowding. So far as the other meteorologic observations are concerned, there is nothing unusual as in comparison with the period of the last ten years.

The time it took to exhaust the susceptible material was not more than eight weeks in any one place. The death rate was highest in manufacturing and lowest in strictly rural communities. All towns untouched by railroads showed a very low death rate. Conditions of housing and crowding which increased indoor contact, no matter where found, increased the death rate. The comparison of these rates with the proportion of foreign- and native-born shows that in the communities having the highest and lowest percentage of native born, the death rate rises or falls accordingly, as a high percentage of American-born means less crowding and better sanitary conditions generally.

The study of the Student Army Training Corps and students wherever located, shows that as living conditions approach those in the Army, so does the death rate approach that of the Army, i.e., when a large number of persons live, sleep and eat together in a large barrack room, the death rate is almost invariably higher. This is true no matter where people are housed in this manner, whether in army camps, miners in South Africa or the congested sections of our cities with their apartments, flats and tenements. It is noteworthy that in many of our large western and southern cantonments the morbidity and mortality was as high or higher than in many of our eastern camps, so that climatic influence does not explain the difference nor does it explain the difference in morbidity of influenza in cantonments of 15.9 per cent. being complicated with pneumonia in barrack camps

against 9 per cent. in tent camps where the men were quartered in small groups of five or six men to a tent against 50 to 150 in a barrack building.

This has also proven quite true of institutions and industrial plants where the same sort of housing has occurred. Already we have been impressed with the heavy sacrifice in human lives demanded for the privilege and necessity of assembling large numbers of men in barracks for military, industrial and educational purposes. So great has been the advance of military medicine and sanitation that one military authority has said that, "Military medicine consists only of three chapters, as follows: Chapter I, The Sputum-borne diseases; Chapter II, The Venereal Diseases; Chapter III, The Insect-borne Diseases. The chapter that most interests us is the first, the sputum-borne diseases, because it is the most important from the standpoint of climatology. They are tuberculosis, pneumonia, influenza, tonsillitis, bronchitis, measles, mumps, scarlet fever, whooping cough, diphtheria and cerebro-spinal meningitis, and the sequelae of these diseases." It seems well established that this group of infections is not ordinarily air-borne. Nevertheless, it is quite certain that they are transmitted through the medium of respiratory exhalations containing droplets of mucous enveloping disease germs. But this has no relation to any atmospheric conditions as such, unless the natural atmospheric conditions are influenced by housing or in some other manner by the hand of man.

In the barracks cantonments epidemic bronchitis was the earliest respiratory disease to be met. This disease prevailed in all camps. At the Oglethorpe group of camps over 80 per cent. of all troops had it and although some may regard bronchitis with considerable indifference, yet I believe it is a medical entity of great significance. Laboratory findings do not agree on any single organism for its cause. It is a poly-bacterial disease. Streptococci, staphylococci, influenza and other organisms were found, yet the clinical picture was very much the same in all. During the winter months of 1917 almost everybody who went

into barracks developed the disease within a week. This was especially true of the Medical Officers' Training Camp, and after seeing many cases and demonstrating it to several classes, I dubbed it "barracks bronchitis." The explosive cough, the tightness of breath, the sub-sternal pain with temperature from 100° to 103° were always noted. Auscultatory signs were the only physical signs present at first. The chest was dry, but the congestion extensive as shown by the radiograph in many instances. This general bronchial congestion went through a stage or resolution and the dry stage was followed by a shower of fine mucous râles occurring with inspiration and expiration and in turn by mixed indeterminate râles accompanied by profuse muco-purulent expectoration which frequently lasted for many weeks. Resolution was usually complete although there were not infrequently cases in which resolution was not accomplished and in which localized area more frequently at the base, but occasionally in the upper portion of one or both lungs, would show fine inspiratory râles accompanied by an irregular slight P.M. temperature. These latter cases were very confusing, especially if you first saw this end stage of localized unresolution. The cases were sent to the examining boards with a diagnosis of acute tuberculosis. These localized râles in the apex sometimes persisted for a long time as well as expectoration, which was negative for tubercle bacilli.

But with the poly-bacterial laboratory report received, the part that bronchitis played in the spread of other sputum borne diseases is worthy of consideration. This was especially noted in cases of bronchitis which developed measles. In this instance it almost equalled broncho-pneumonia and it is sad to state that nearly sixty per cent. of these cases meant death. It is also believed to have played an important part in the spread of the other sputum borne diseases.

What relation was there between bronchitis and climate? The weather may have encouraged it, while there was a good deal of cloudiness and perhaps unusually cold weather in the

fall and winter of 1917, yet there was no unusual humidity or precipitation—only the snow fall was greater.

I think we must admit, however, that climate, so far as seasons go, does play a great part in the incidence of acute respiratory diseases, especially pneumonia. We must look farther than climate, however, for the explanation of these diseases during the winter of 1917. I have always believed that no climate can rise above the conditions of housing. The quartering of troops in unaccustomed climates will not explain it, but the housing of a large number of men together in one room with the change from over-heated home to the more or less cold barracks system of many of our camps, will account for much of it, but this condition was not confined to our army camps. Acute respiratory conditions were on the rampage during the winter of 1917 among the civilian population, and I believe the foundation for the pandemic of the autumn of 1918 was then laid.

The following statement may surprise you all, but I believe that the fuel administrators had the most to do with the causes which led up to the titanic struggle between bacterial and human life. Not that they were to blame. It was a military necessity. And, my friends, it is impossible for us to play at this war game without paying for it in both the front line and the extreme rear line, or the homes that were necessarily mobilized for war purposes.

During the winter of 1917, on account of fuel shortage many people were obliged to close a large part of their houses and to live in a few rooms. This was especially true of the poor. Apartment houses were crowded and poorly heated. The people who could afford it flocked to hotels, many of which were under-heated and over-crowded. People crowded together as never before witnessed in the civil population of all countries. Windows and doors had to be kept closed to keep the cold out, which resulted in a concentration of bacteria-laden, indoor air, due to coughing and sneezing. The acute respiratory conditions in 1917, I feel, had some very definite relation to those in 1918.

As the warm weather approached in the summer of 1918, these conditions subsided because windows were opened and people had reopened their closed rooms; the concentration of germ-laden air had become diluted and it almost appears that a certain concentration is necessary for the spread of some of these diseases.

As we have seen by various laboratory reports the complications of influenza were poly-bacterial, depending upon the section of country reporting—here streptococci pandemicus, there pneumoniæ pandemicus, and in some places staphylococci. In most instances the bacillus of Pfeiffer was ever-present, preparing the soil in the bronchial mucosa which had already been partly prepared by the bronchial conditions of the previous winter months. During the summer of 1918 these conditions continued to some extent, but they were notable for their mildness. What, then, accounts for the sudden virulency and onslaught of the bacteria in the fall of 1918? Bacteriologists are all familiar with the increase in virulence of strains of pneumococci passed rapidly through a succession of susceptible animals like the rabbit. Is it not reasonable to suppose that this is what happened during the summer of 1918 and with the advent of cold weather and with the unusual period of rainfall coupled with a still greater preparation to live in as few rooms as possible due to the shortage of fuel, and which actually had driven the poor to a smaller number of rooms and consequently back to a concentrated bacterial indoor atmosphere accounts for the sudden onset of the disease. And the bacterial content of this atmosphere had now attained a virulence which did not exist in 1917 and which was now able to overcome and destroy the white corpuscles and subsequently the individual. Every case we observed had a leucopenia with the exception of one, and in this case there was some very unusual condition not determined by the clinicians.

I have failed thus far to show any meteorological factor that influenced the pandemic with the exception of change in seasons. Does climate have any effect on the bacterial flora in any sense

as it does on our terrestial flora? This is a question that will bear some investigation. We are shown in studies of the epidemic that in some localities streptococci are responsible and in others that pneumococci are responsible for the broncho-pulmonary and pleuritic complications. By comparing the average of death rates from influenza it was found that there is a distinct relation between the two—that is, a community having a large death rate from pneumonia had a high death rate from influenza last winter and those having a low death rate from pneumonia had a low death rate from influenza. This relations is shown undeniably in the recent pandemic by comparing 45 large cities with the average pneumonia rate for the last sixteen years.

It may be asked why the entire population was not afflicted, which may be answered that immunity following previous epidemics may account for only 40 per cent. of the population being attacked in 1918. In the epidemic of 1890 about 40 per cent. of those exposed took the disease. All ages were attacked, but mostly those between the ages of 15 and 50 suffered. Statistical data concerning previous epidemics are so meager and imperfect, but in 1823 about 40 per cent. of the population of Paris was afflicted. In 1872 about 70 per cent. of the population of London and some of the German cities were said to have suffered. But the records of earlier epidemics are so obscure that they are of little or no value going back even to the first one imperfectly recorded in 1173.

It has been shown that more than 100,000 persons between the ages of 25 and 45 succumbed to this respiratory condition in the civilian population in 1918. A widespread epidemic caused by a specially virulent virus is usually followed by a general immunity of that portion of the population infected. Local outbreaks or sporadic cases may occur and probably will for the next few years, but the general immunity will protect against any general epidemic. Following a period of years a new susceptible population will replace the immune one and with the introduction of fresh varulent virus another general epidemic

may be looked for. This, I think accounts for the great susceptibility of young persons under 45 in this epidemic. It is 28 years since the last epidemic and as few were attacked in 1890 under 15 years of age, one would not expect many persons over 45 to have developed the disease this year.

I feel that climate will have little to do with the next outbreak, but it will come, perhaps not in my time and perhaps not for a longer period of time, but you climatologists who are present when a new susceptible population is established need not study meteorological influences or protections against it only so far as it concerns seasons. I do earnestly urge you to study housing, ventilation and sanitation and to be ever on the watch for business depressions, social problems, such as widespread strikes and new wars, which for economic reasons will cause people to live under restricted and crowded conditions.

DISCUSSION.

Dr. Pottenger: This paper of Dr. Nichols' is one of great interest to the members of the Climatological Association. There are just a few points that I would like to make. In the first place, referring to the question of contact and influenzal infection I would like to cite a few instances which point to the fact that people may become carriers of influenza. It has been reported to me, but I can not vouch for the truth of it, that sheep herders out in the mountains many miles away from civilization developed influenza. Another instance was given me by my colleague, Dr. Granville MacGowan, of Los Angeles, who had charge of a vessel sailing to the Orient during the influenza epidemic of 1889–93. He reports that they left San Francisco with a large number of passengers, all of whom had a clean bill of health. When they arrived at Honolulu everybody was still free from disease. There was no contact from the shore, the proper officers coming out in a small boat and executing whatever papers were necessary without contact. A few days later, however, influenza broke out among the passengers and a very large per cent. of those on board became infected. These two instances support the point that influenza is carried in an inactive form ready to break out under favorable conditions.

Dr. Nichols' paper is also very interesting because of its discussion of the relation between disease and climatic conditions. In this connection I would like to call attention to the work of Professor Elsworth Huntington. He has shown the influence of many

different factors such as heat, cold, humidity and dryness upon the human efficiency, morbidity and mortality. He has shown, contrary to what most of us believe, that the most favorable climate, as far as health is concerned is one in which the air is moderately moist, and with a temperature which is neither too high nor too low. This must not be interpreted, however, as being best for those who are ill. For these, the climate must suit the disease and the patient. He has shown that a moderate drop in temperature is usually favorable, but that if the cold continues, it is unfavorable and increases the number of deaths. He also shows that a rise of temperature is unfavorable and that it interferes with the well being of the individual.

Studies of this kind belong distinctly to this Association and are helpful in adding valuable facts to our medical knowledge.

Dr. Charles W. Crankshaw: In the city of Newark, which is a great industrial center, we have a population of about 435,000 people and we had some 30,000 cases of influenza. I was requested to serve on the mayor's committee with the health officer and others, and at our suggestion the saloons, soda fountains, churches, schools, theatres, moving picture houses, pool rooms and every place where the public could congregate were closed and for the time being public gatherings were prohibited. All public conveyances were required to keep one or more windows open, and taking the matter from every angle, we had very good coöperation. The number of cases as compared to the population shows that evidently our getting on the job early had something to do with limiting the number of cases. At the Home Office of the Prudential Insurance Company, where there are about 4,500 employed, I wrote a letter to the Home Office employees on September 20, 1918, a copy of which was placed on more than fifty bulletin boards throughout our group of buildings, calling their attention to influenza and gave a few rules to observe. During the epidemic our disability list was never over 12 per cent. or less than 8 per cent. for all causes. We did our best to allay fear; no one was greatly alarmed and by giving them early advice and how to take proper care, I believe that we helped to some extent in checking the spread of the disease.

Dr. W. F. R. Phillips: I think the Association is indebted to Dr. Nichols for giving it a *climatological* paper. Since the Association added to its name and enlarged its scope, it has had few papers dealing with the important relations that obtain with respect to man and his physical environment. I am not surprised that Dr. Nichols finds no consistent relations between the recent influenza epidemic and the climatic conditions. I recall endeavoring to connect the conditions that prevailed during the epidemic of 1898–99, and with the same general result. I think, however, it is rather weather and influenza

than climate and influenza. It is necessary to distinguish between the two terms: climatic effect is a long-time effect, one that it takes decades of years to evidence; weather is a short-time effect, measured in hours or at most in weeks. That we fail to find evidence of climatic effect may be not that there is no climatic influence on influenza, but because we are without the necessary data. It should be remembered that our climatic statistics extend back not very many years, that is, taking the world at large, not more than forty years. Statistical climatology does not even now extend to that region of the world from whence influenza apparently periodically starts on its epidemic progress. When the next pandemic occurs there may be enough data to throw a ray of light on the climatic relations.

It seems regrettable that we are without climatological laboratories for the study of our problems. A number of years ago in my address as president of the Association, I called attention to the need of such laboratories if we were to make any real scientific progress in medical climatology. A few years later I showed in a paper on artificial or house climates read before this Association how in one important manner climate affected our well being. To illustrate, I cited the effect experienced by an individual on going from indoors to outdoors on an average November day in Boston, that it was equivalent climatically to going from Yuma, Arizona, to Boston in the same length of time. There can be no doubt that climate has its effect on us, the whole theory of evolution postulates this effect. We seem, however, satisfied with the postulate and content to let the quantitative and qualitative effect take care of themselves.

THE DIFFERENTIATION OF EARLY TUBERCULOSIS AND HYPERTHYROIDISM BY MEANS OF THE ADRENALIN TEST.

By NORMAN CLIVE NICHOLSON AND EMIL GOETSCH.

From the Trudeau Sanatorium, Trudeau, New York.

The difficulties in the diagnosis of tuberculosis in its earliest stages are apparent to all workers in this field of medicine. Particularly is this true of that large group of patients in whom the familiar syndrome of fatigue, asthenia, loss of strength, loss of weight, nervousness in varying degrees, tachycardia, vasomotor instability and possibly slight elevation of temperature, would make one suspicious of tuberculosis, but in whom the physical signs, laboratory and x-ray findings are insufficient for a positive diagnosis.

How frequently indeed one meets patients, who, under the suspicion of tuberculosis because of just such symptoms, have undergone a most rigid antituberculosis therapy; extending in some instances over years. Not only have they followed the antituberculosis therapy; they have indeed subjected themselves to every form of therapy calculated to benefit them, such as rest, extra feeding, exercise, work, change of climate, possibly even surgical measures, but all to no avail—their symptoms have remained unimproved.

An equally difficult problem is presented by another group of cases in which there is a tuberculous lesion definitely demonstrable by physical signs and x-ray, which, however, after a sufficient length of treatment may or may not show retrogression, and which is still accompanied by symptoms of rapid pulse, fatigue, and possibly slight elevation of temperature. Here it is questionable whether the symptoms can be attributed to the tuberculous lesion. Especially is this so, if after six months

rest cure the pulmonary condition shows improvement both from physical signs and x-ray findings.

Regarding both of these groups the question naturally arises: Are these symptoms referable to the tuberculous lesion, are they a residual syndrome of previously active tuberculosis, or are they due to an entirely different cause?

It is our belief that in some of these cases the symptoms are due definitely to hyperthyroidism.

Our problem then has been to discover the presence of hyperthyroidism. In the absence of a clear-cut history and physical examination warranting the diagnosis, a clinical test which would reveal the presence of hyperthyroidism would naturally be of the greatest importance. Such a clinical aid and test is available. We refer to the use of adrenalin to elicit a state of hypersensitiveness of the sympathetic nervous system such as is present in conditions of hyperthyroidism. We feel that the determination of a state of constitutional hypersensitiveness to adrenalin, injected subcutaneously, warrants the belief that a clinical state of hyperthyroidism exists. The use of this test by Goetsch* over a period of three years in conditions of hyperthyroidism, which were later confirmed by operation and microscopic study of the gland-tissue removed, has convinced us of the reliability of the adrenalin hypersensitiveness test.

To support our contention, which is that hyperthyroidism is responsible for the general symptoms usually attributed to tuberculosis in most of the cases where the presence of clinical tuberculosis is questionable, and also where the tuberculous lesion is thought to be insufficiently active to account for the severity of the symptoms, we applied the adrenalin test, at first to those patients in whom the diagnosis of tuberculosis was questionable, and later upon the suggestion of the medical staff as a routine measure to all patients entering the Trudeau Sanatorium. By so doing it is clear that, hypothetically, we should

* *New York State Journal of Medicine*, July, 1918.

be dealing with three classes of patients: first, those with frank tuberculosis; secondly, those with hyperthyroidism complicating the tuberculosis; and thirdly, those with definite hyperthyroidism only. There are patients who present the above-mentioned syndrome of symptoms common to all of these groups, namely, fatigue, asthenia, loss of weight and strength, increased or normal pulse rate, nervousness, and possibly slight elevation of temperature. It is this very similarity in the symptoms exhibited by these groups which has hitherto made the differential diagnosis so difficult.

Positive results in support of this view have been obtained in the comparatively brief time that we have been at work on the problem and we think these justify this preliminary report. A few of the adrenalin tests were carried out by Dr. Foster Murray of the sanatorium staff.

The technique of carrying out the test is as follows:

We want the patient to be as calm and restful as possible before the test so that the reaction to the adrenalin will stand out sharply in contrast. Accordingly the patient is put to bed the previous day and is reassured by the attending physician that the test will be in no way painful or associated with any danger. At this time, too, the standard case-history is supplemented by a history taken with special reference to symptoms of thyroid disturbances. One must determine the presence or absence of nervousness, throbbing, tachycardia, tremor, depressions, crying spells, struma, apprehensions, hot and cold flushes, cold hands and feet, fainting spells, memory lapses, and gastro-intestinal upsets. The regular routine physical examination is amplified by a detailed scrutiny of the signs suggestive of hyperthyroidism, such as positive eye-signs (Joffroy, Moebius, von Graefe and Dalrymple), tremor, struma, thrills or bruits over the thyroid, throbbing of the carotids and of the abdominal aorta, dermatographism, the condition and distribution of the hair, and slight edema of the eyelids, legs or hands. In this connection it should be borne in mind that hyperthyroidism may

exist with negative eye signs and only indefinite clinical findings in the thyroid gland. Consequently we feel that the response to adrenalin is a much more dependable criterion of hyperactivity of the gland.

On the day of the test the patient is placed as nearly as possible under normal conditions. By this we mean in a warm room without the appliances such as hot water bottles, heating devices, which are common to the outdoor treatment of tuberculosis. The patient, of course, is to take his meals in bed. We emphasize these precautions because of the well-known hypersensitiveness and irritability of hyperthyroid and tuberculous patients. Because of the tendency of the thyroid to hyperactivity at the menstrual period the test is not given during this time.

We proceed with the test as follows[1]:

Two readings are taken, at five-minute intervals, of the blood pressure, systolic and diastolic, pulse rate, and respiration. A note is made of the subjective and objective condition of the patient. This includes the state of the subjective nervous manifestations, the throbbing, heat and cold sensations, asthenia, and the objective signs, such as pallor or flushing of the hands and face, the size of the pupils, throbbing of the neck vessels, and precordium, tremor, temperature of the hands and feet, perspiration, and any other characteristic signs or symptoms noticed. These signs are all noted previous to the injection of the adrenalin so that comparison may be made after the injection.

A hypodermic syringe armed with a fine needle which, when inserted, causes little discomfort, is then used to inject 0.5 c.c. (7.5 minims) of the commercial 1–1,000 solution of adrenalin chloride (Parke, Davis & Co.) into the deltoid region, subcutaneously. Intramuscular and intravenous injections are not given. Readings are then made every two and one-half minutes for ten minutes, then every five minutes up to one hour, and then every ten minutes for half an hour or longer. At the end of one and a half hours the reaction has usually entirely passed

off, sometimes earlier. The repeated early readings are made in order not to miss certain reactions on the part of the pulse and blood pressure that may come on in less than five minutes after the injection is made. This is particularly true of cases of active hyperthyroidism.

In a positive reaction there is usually an early rise in blood pressure and pulse of over ten points at least; there may be a rise of as much as fifty points or even more. In the course of thirty to thirty-five minutes there is a moderate fall, then a second slight secondary rise, then a second fall to the normal in about one and one half hours. Along with these one sees an exaggeration of the clinical picture of hyperthyroidism brought out, especially the nervous manifestations. The particular symptoms of which the patient has complained are usually increased, and in addition there are brought out many symptoms which have been latent. Thus it is not uncommon to have extrasystoles brought out, after the injections of the adrenalin. The patient is usually aware of them and may tell one that she has felt this same thing a year or two previously, at which time the symptoms of the disease were more active.

The following may all or in part be found: increased tremor, apprehension, throbbing, asthenia, and in fact an increase of any of the symptoms of which the patient may have complained. Vasomotor changes may be present; namely, an early pallor of the face, lips, and fingers, due to vasoconstriction, to be followed in fifteen to thirty minutes by a stage of vasodilation with flushing and sweating. There may be a slight rise of temperature and a slight diuresis.

In order to interpret a test as positive we have regarded it as necessary to have a majority of these signs and symptoms definitely brought out or increased. Thus there is at times a considerable increase of pulse rate without much increase in systolic blood pressure, but with a considerable increase or exacerbation of the objective signs and symptoms; or there may be an increase of ten points in the pulse and blood pressure and

a moderate increase of the symptoms and signs; or again, there may be only slight changes in pulse and blood pressure and considerable change in signs and symptoms. These may be regarded as positive. In a word, then, one must consider the entire clinical picture produced in order to gain a correct interpretation, just as in the disease itself one cannot expect every one of the characteristic signs and symptoms to be present in order to make a diagnosis.

In this report it is our desire to present briefly the results thus far obtained in our studies of 107 cases. The diagnosis of these, as made by the sanatorium staff, places them in the three following groups: (1) In the first group there are 37 in whom clinical tuberculosis was questionable; (2) in the second group there are 52 with inactive clinical tuberculosis; and (3) in the third group there are 18 in whom clinical tuberculosis was definitely active. The terms "active" and "inactive" are based upon the latest conception of the Trudeau staff, as set forth in a recent article by Brown and Petroff.[2]

As is indicated in the tables below, of the 37 cases belonging to the "clinical tuberculosis questionable" group, there were 21 who reacted positively to the adrenalin test, and 16 who showed an entirely negative reaction. We wish to emphasize the fact that in practically all the cases of this group there was a clinical syndrome which was suggestive of either incipient tuberculosis or possible hyperthyroidism. In the 10 cases with a positive adrenalin hypersensitiveness the intensity of the reaction varied in a way remarkably parallel with the severity of the symptoms exhibited by the patient. Furthermore, the majority of these cases showed only indefinite signs of hyperthyroidism by physical examination and therefore had it not been for the additional diagnostic help afforded by the adrenalin test it would have been impossible, we feel, to state definitely whether or not hyperthyroidism was responsible for their symptoms.

In Group 2, namely the "clinical tuberculosis inactive" group, some of whom presented the symptomatology common

to both tuberculosis and hyperthyroidism, others a symptomatology not characteristic of either condition, we found that out of the 52 cases, 16 showed a positive response to the adrenalin test. The suggestive symptoms and physical findings, but particularly the positive adrenalin reaction, permit us to say definitely that these patients were suffering with hyperthyroidism, varying in degree from mild to moderately positive. The hyperthyroidism in these cases was a complicating feature in their tuberculosis.

To our great satisfaction we found in Group 3, consisting of 18 cases in whom there was a definitely but moderately active clinical tuberculosis, that the reaction to adrenalin was negative in all of them. We wish to point out, however, that in three cases there was a late slight atypical reaction, namely, a rise in blood pressure and pulse at the end of an hour or an hour and one half, which is quite contrary to the typical hyperthyroidism reaction in which, at this time, the pulse and blood pressure are approximately the same as before the test. Furthermore, there was a conspicuous absence of the symptoms and signs so characteristic of the adrenalin response in hyperthyroidism.

We have listed the cases belonging to the three groups discussed above. The degree of the response to the adrenalin we have conveniently designated by the use of the + sign. A mild response is indicated by the use of +, a moderate by ++, and a marked response is indicated by +++. A negative reaction is indicated by the zero sign.

	Clinical Tuberculosis Questionable, Adrenalin Reaction.	Clinical Tuberculosis Inactive, Adrenalin Reaction.	Clinical Tuberculosis Active, Adrenalin Raaction.	Total.
Positive....	21	16	0	37
Negative...	16	36	18	70

Analysis of Results.

The importance of being able to diagnose a condition from which many patients suffer, namely a syndrome similar in many

respects to that of early tuberculosis, in whom, however, clinical tuberculosis is not proved, is apparent to all workers in the field of tuberculosis. In fact there must be many patients presenting themselves at sanatoria for tuberculosis with symptoms which appear not to be accounted for by the amount of tuberculosis, either active or inactive, which they have. Of this fairly large number of patients, we feel, as a result of our brief studies that there is a considerable percentage suffering from hyperthyroidism. We have come to this conclusion as a consequence of the fact that there is in many of these patients a positive adrenalin hypersensitiveness. Furthermore, confirmatory support is afforded by a carefully taken history and physical examination.

We wish to make clear that in the first place the constitutional hypersensitiveness to adrenalin is an indicator of excessive thyroid function. According to the degree of the response we are permitted to draw conclusions as to the degree of thyroid overfunction. Consequently, there must of necessity be all degrees of thyroid overfunction from the mildest to the most marked. There are doubtless many individuals with a mild hyperthyroidism who respond mildly to the adrenalin test, and who have not been greatly annoyed by their symptoms. The fact that these patients react mildly to adrenalin does not mean, in our opinion, that they should receive medical and possibly surgical treatment for this hyperthyroidism. These individuals are living in comparative comfort as far as their hyperthyroidism is concerned, and are not incapacitated by it. Rest and a well-regulated hygienic life is indicated for them whether they have or have not tuberculosis. If, however, the hyperthyroidism is incapacitating or even of such a degree as to be definitely annoying, then after the failure of a faithfully carried-out rest and hygienic regimen, it is time to think of surgical measures.

In those unfortunate individuals suffering from both tuberculosis and hyperthyroidism, the problem becomes more complex. It is of course apparent that the very nature of hyper-

thyroidism is such as to make it impossible for them to carry out the rigid rest regimen which their tuberculosis requires. The well-known nervousness and often extreme restlessness of these patients might readily defeat the ends to be gained by a well-regulated rest cure. On the other hand a surgical operation, unless definitely advisable, might be contraindicated on account of the nature of the tuberculosis present. The question as to whether the tuberculosis or the hyperthyroidism is to receive predominant attention at the beginning of treatment rests with the physician in charge.

Another point we wish to bring out is that a mild hyperthyroidism may have existed in an individual years before the symptoms become so severe as to cause the patient to seek medical advice. When finally the patient does seek aid, he is found to have a rather clear history of hyperthyroidism; the physical findings may or may not be especially prominent, but there is a moderate or marked reaction to adrenalin. This would mean to us that his disease has reached the stage where medical or surgical treatment is necessary. The situation here is analagous to that in tuberculosis where there may be an incipient stage of the disease not apparent to the patient, which later develops into a frank clinical tuberculosis. Our point is this: that it is just as wrong to say that a patient with a mild adrenalin hypersensitiveness has not a mild hyperthyroidism which may not require treatment at the time, as it would to be say that a patient had had his tuberculosis only during the time that it was clearly active.

It should be mentioned furthermore that the adrenalin hypersensitiveness reaction affords us a means of early diagnosis of hyperthyroidism at a stage before the disease has seriously damaged the individual or perhaps incapacitated him. It thus allows us to appreciate an early mild hyperthyroid element in tuberculosis should the two diseases exist concomitantly. The interesting question as to whether a mild hyperthyroidism may not have been the causative factor in his subsequent break-

down with tuberculosis, or whether the tuberculosis may in some instances elicit a mild hyperthyroidism, we shall not attempt to discuss in this preliminary report.

Summary.

In probably every sanatorium for tuberculosis, and in fact in the practice of every physician interested in this disease, there are patients who symptomatically might be considered as having either incipient tuberculosis or mild to moderate hyperthyroidism or both. The problem then is one of determining whether these symptoms are due to tuberculosis or hyperthyroidism or both. In many instances the severity of the clinical syndrome appears to be out of all proportion to the amount or activity of the tuberculosis present. Heretofore it has been a matter of opinion and oftentimes a diversity of opinion among members of the same staff as to whether the amount and activity of tuberculosis present was to be considered responsible for the symptoms. Naturally, when the diagnosis depended upon such a difference of opinion difficulties arose, and in the end the patients have doubtless often suffered. We feel justified at the present time in offering a diagnostic help in these cases, namely, a means of determining whether the disease from which the patients are suffering is purely a tuberculosis, a tuberculosis complicated by hyperthyroidism, or a pure hyperthyroidism. This diagnostic aid consists in the determination of the constitutional hypersensitiveness to adrenalin. Hyperthyroidism, whether or not associated with tuberculosis, will give a positive reaction to adrenalin. Tuberculosis uncomplicated by hyperthyroidism, as it appears from our brief series of cases, does not react positively to adrenalin. We feel that in a considerable number of border-line cases presenting symptoms more or less characteristic both of tuberculosis and hyperthyroidism, we can now pick out those suffering with hyperthyroidism. The value and importance of such a diagnostic aid to the patient need hardly be mentioned.

In conclusion, we wish to thank the members of the medical staff of the Trudeau Sanatorium, for their ever-ready help and interest.

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Dr. Pestler: I followed it with a great deal of interest and tried it in some of my own cases. We have certainly been at a loss at times to make a diagnosis of incipient tuberculosis and this test is enabling us to differentiate this condition from hyperthyroidism. In this group there is no question but that the adrenalin test is of very great help indeed.

APICAL TUBERCULOSIS AND THE ORTHOGRADE POSTURE.

An Hypothesis to Account for the Apex of the Lung as the Locus of Incipient Pulmonary Tuberculosis.

By W. F. R. PHILLIPS, M.D.,

CHARLESTON, S. C.

Hypotheses and theories are tenable and to be judged only so far as the postulates on which they are founded are real and not merely apparent. Future observation and investigation may show that some of the accepted propositions of today relative to human tuberculosis are either misinterpreted or erroneous. The apparent conditions relevant to the subject of this paper may be summarized as follows:

Tuberculosis in infants is glandular and abdominal; in adults it is pulmonary and, almost always, apical in the beginning. Between these two periods of life it is transitional, that is, it passes with varying uniformity of manifestation from glandular to pulmonary and from abdominal to thoracic as the individual passes from the infant to the adult. Collateral, and more or less synchronous, with this passage the orthograde posture becomes more and more the habitual posture of the waking hours of life. The passage from the supine of the infant to the erect of the adult introduces changes in the hydrostatics and hydrodynamics of the circulation which the organism is obliged to meet. Under the influence of gravity the blood accumulates in the more dependent portions of the great vascular reservoirs of the body in greater or less degree, depending on the intrinsic tonicity of the vascular system and the extrinsic tonicity and activity of the somatic musculature. Any and every change of posture from supine to erect requires a readjustment of the blood dis-

tribution and, conversely, from the erect to the prone or the supine. For example, in the supine posture the capillaries of the dorsal portion of the lungs, from apex to base, will be flooded with blood, whilst the ventral capillaries will not be well filled and, indeed, may be all but collapsed. Changing to the upright posture, the basal portions of the lungs become hyperæmic and the apical portions anæmic. Analogous changes take place in the liver and in all other parts of the body. The dynamics of the circulatory apparatus are called on to vary their activities to meet these variations in the statics of the circulatory distribution of the blood. To give an illustration: The blood column in the venæ cavæ must always be at the level of the highest point of the tricuspid orifice, if it be not, the ventricle is not filled when systole takes place. In the supine posture gravity alone will maintain this level; in the erect posture gravity alone will displace this level to the vena cava inferior and to a point below the level of the diaphragm. Yet in the erect posture the blood column fills the inferior vena cava and upwards to the highest point of the tricuspid orifice. To maintain this inferior level, or meniscus, of blood always at and no higher than the tricuspid valve is one of the functions of the postural tonus of the abdominal muscles and of the unstriped muscular tissue of the abdominal viscera; because the contractile power of the veins and capillaries is not equal of itself to accomplish the task. This postural tonus is the resultant of dynamic activities called into play in the tissues concerned, it is not a static or passive condition. All this has been established experimentally by numerous observers.

These changes in the static and dynamic conditions of the organism occasion many and complex changes and readjustments in the other functions of the body. To review them even synoptically is not practicable in a single paper. Even to present all the phases of these adjustments and readjustments that may play important parts in the hypothesis which is addressed to your attention is not practicable; only some two or three manners

in which the changes of the blood distribution due to postural changes can be considered. The degree of physical and physiological efficiency with which the organism responds to these changes, is one of the measures of the organism's preparation for living, of its fitness to survive.

The hypothesis formulated on the facts and postulates thus briefly referred to may be stated as follows: In the assumption of the orthograde posture gravity causes the bulk of the blood of the pulmonary circulation to flow through the lower portions of the lungs; the capillaries of these portions are filled to a certain degree of overdistension, whilst the capillaries of the upper portions, particularly the apices, are but meagerly filled with blood and their walls more or less collapsed. The resultant being that conditions are produced which afford opportunity for the lodgment and development of the tubercle bacillus in one or more of the manners to be set forth. As a lemma to this hypothesis, if under the hydrostatic conditions imposed on the circulatory mechanism by the assumption of the upright posture, the organism is able to maintain a certain minimum circulation through the apices of the lungs, apical tuberculosis will not develop, and, as a corollary, pulmonary tuberculosis as a primary disease will not occur. However, this hypothesis should not be taken too rigorously, because we must admit that there is still question as to just where in the lung tuberculosis makes its beginning; whether it is essentially a lesion of the pulmonary parenchyma, or an extension by way of the lymphatics from the lymphatic glands, or by the blood stream from these glands, or from some other primary locus elsewhere, and, finally, whether there is any locus of the lungs more peculiarly susceptible to tuberculosis than another.

At this point, it will be well to mention some of the theories and hypotheses previously advanced to account for the generally accepted view that the apex is the almost invariable locus of incipient pulmonary tuberculosis in adults.

Freund[1] advanced as an explanation the existence of sym-

metrical and asymmetrical stenosis of the upper thoracic aperature. Birch-Hirschfield suggested abnormalities of the bronchus apicis posterior. Pressure of the first rib on the apex was assigned by Schmorl, and exostosis of the angle of Ludwig by Rothschild. Campbell[2] suggested as a cause the intra- and extra-thoracic conditions of the apex of the lung in a relation to the effect of atmospheric pressure. "The extreme apex in man," he writes, "being extra-thoracic, . . . on inspiration the intrathoracic lung is under a pressure less than that of the atmosphere, but the apex is subject to the atmospheric pressure which is communicated to it by the soft parts covering it; this air meets the incoming air from the trachea and large bronchi, and the pressure becomes equalized. The result of this is, that on inspiration only a small quantity of oxygenated air reaches the apex. Again, on expiration, the pressure on the apex being that of the atmosphere, and hence less than that of the rest of the lung, air rich in carbon dioxide, but poor in oxygen, is forced into it. From the above it follows that the contents of the apex are under most unfavorable conditions for becoming aërated, and the vitality of the tissues is lessened, and hence their resisting power is lowered." Jones[3], studying the anatomical relations of the apices in relation to phthisis, explains apical tubercular infection as due to the close relation of the dorsal apical portions of the lungs to the thoracic and the right lymphatic ducts; these two vessels being separated from contact with the lungs in this region only by the thickness of the two pleural membranes. Jones discovered an actual case of incipient apical tuberculosis involving the thoracic duct at this locus. From the pathological appearances, Jones was inclined to regard the duct as the primary seat of the lesion in this case, hence his theory of the mode of infection. Aufrecht[4] has advanced the theory that the bacilli gain entrance to the great veins and find lodgment in the terminals of the pulmonary arteries at the apex. But how it comes about that these arteries afford such lodgment more than the other arteries is not stated. Bonney[5] accepts

Aufrechts theory, which he states, "effectually disposes of the common error that the site of the initial lesion is indicative of the point of entrance of the bacillus." According to Bonney, Aufrecht's theory has been experimentally verified by Calmette and others. The hypothesis I here offer is consonant to a certain degree with Aufrecht's theory, though it is not offered either as a support or a modification of that theory.

The total quantity of blood in the human body has been variously estimated and different values obtained by different observers. What may be regarded as the probable mean is that the blood constitutes 7 per cent. of the body weight. According to Leonard Hill,[1] from 50 per cent. to 70 per cent. of the total blood of the body is in the abdominal and thoracic viscera during inactivity and about 36 per cent. in the muscles when at rest. When active or working, about 66 per cent. of the blood is in the muscles. The abdominal and thoracic viscera, therefore, are in reciprocal relation with the muscles of the body during rest and exercise. The mechanism by which this reciprocal relationship is maintained is complex and its consideration can not be entered into here. It is, however, the physical and functional efficiency of this mechanism that determines the reaction of the blood and the lymph circulations to the static influence of gravity, and which regulates the volume of blood that at any moment may be found in any part of the circulatory system.

Experiments on animals have shown that not more than one third of the pulmonary vascular system is required to convey the pulmonary blood under the ordinary conditions of rest and moderate activity. Clinical observations on man have shown, over and over again, that at least one half of the lungs can be consolidated to a degree inconsistent with its functioning as a part of the pulmonary circulatory system, and yet the circulation go on without any observable impediment. These facts indicate that under normal conditions of rest and moderate activity not more than half the capillary system of the lungs is

necessary to carrying on the circulation. However, it does not follow necessarily that there is no blood flowing through all the capillaries, but it does follow that the same rate of flow and a full volume of blood are not maintained in all the pulmonary capillaries at all times and under all conditions. There is not the muscular mechanism in the thoracic cavity for aiding the capillary vascular system of the lungs that there is in the abdomen for aiding that of the abdominal viscera. The only effective muscles of the thoracic cavity are the unstriped muscles of the blood vessels themselves, and very indirectly the diaphragm. Whilst the capillaries are devoid of muscular tissue, they have, however, a certain contractile power, resembling that of the amœba somewhat, by which they may vary their caliber, as seen in their reactions in the phenomenon of inflammation. But this power is of short endurance and is soon exhausted for the time being. It is not probable, in the present state of our knowledge, that these capillaries can so alter their calibers as to maintain for any length of time against the influence of gravity a uniform distribution of blood throughout the pulmonary mass; what we know is against such a possibility.

The great vascularity of the lungs is such that each lung may be regarded as a single blood vessel of its own shape and size, and, as such, subjected to the hydrostatic pressure of its contained volume of blood, with this important exception, that instead of rigid walls, or even of the strong musculo-elastic walls of the systemic arteries, the walls of this lung vessel are easily distensible and do actually distend considerably under the hydrostatic pressure of its contained fluid. The extreme vertical height of the lungs is approximately seven inches. The hydrostatic pressure, if the lungs were filled with blood, would vary from zero at the apex to 13 mm. Hg, in round numbers, at the extreme base. The pulmonary vessels enter and emerge from the lungs a little above the midpoint of the vertical pulmonary plane. The capillaries below the level of the pulmonary veins, be the position of the body what it may, are of necessity always full of blood and

distended to a degree dependent on their intrinsic resistance and the hydrostatic pressure prevailing at the moment; those above the level of the veins will contain varying volumes of blood and be under varying hydrostatic pressure according to the volume and rate of flow of the blood through the pulmonary system at the time, and these will depend on the physiological activity and demands of the individual at the time. In the erect posture the basal capillaries will be subjected to a hydrostatic pressure of from greater than zero at the level of the lowest pulmonary vein to 6 mm. Hg, in round numbers, at the lowest level of the lung. Any increase in pressure due to the existence of a higher blood column level in the lungs will be additive to these pressures.

As already stated, experiments and clinical experience have demonstrated that the vascular system of the lungs is more than double the capacity needed to convey the volume of blood continuously flowing through them, therefore it follows that there are many times when considerable spaces of lung capillaries above the pulmonary vein levels are virtually devoid of blood. The walls of these capillaries will be more or less collapsed, introducing a greater resistance to the passage of whatever blood stream there may be moving through them at the moment. If foreign particles, such as germs, carbon, silicious and other sorts, should be in the stream, they will be more than likely arrested in these narrowed or collapsed capillaries. It is conceivable that in this way tubercle bacilli if in the blood stream, as postulated by Aufrecht in his theory of tubercular infection previously referred to, may be filtered out, that is, jammed between the endothelial cells of the capillaries, cells endowed with phagocytic properties, which engulf these and other foreign matters brought in intimate and sufficiently prolonged contact with them. Under certain conditions, such as fatigue, heredity, and the other things of the somewhat long catalogue of predisposing causes that we take refuge in, it is conceivable that the phagocytic proclivity of these endothelial cells when associated with a diminished, or even absent, phagocytic power may

be the actual way in which the bacillus is planted in the interstitial spaces in which it subsequently grows and multiplies. Aufrecht[4] states that in incipient cases of porcine tuberculosis he has found the bacilli actually in the walls of the blood vessel. But this is not the sole way by which this relation of the vascular capacity of the lungs to the blood volume and the physiological consequences of this relation incident to postural change, may be connected as etiological factors in the predilection of incipient tuberculosis for the apical regions. A large speculative field is opened which it is not possible to explore in the time at present available. I shall refer but briefly to two or three other possibilities.

It is conceivable that the relative absence of a blood stream for considerable periods—two, four, six, eight or more hours—as must often obtain in the apices when the body is erect, may of itself induce changes in the endothelial or the epithelial or the interstitial cells or all three, that may make them more susceptible to the invasion of tubercle bacilli. It is conceivable that there may be quite a deleterious effect on both the endothelial cells of the capillaries and the epithelial cells of the air sacs caused by an excess of oxygen in the apical alveolar cells. Or to put it another way: In the absence of an adequate blood stream passing through the apical capillaries, the oxygen actively taken up by the respiratory epithelium not being taken away rapidly enough becomes in itself more or less noxious to these very cells; or the deficient blood stream may interfere with the carbon dioxide balance of the apical tissues, these tissues may become too poor in carbon dioxide as well as too rich. Deficient oxygenation of the red cells of the blood has so long held the center of the stage that we loose sight of the fact that an excess of oxygen is harmful to tissues, quite as much so as a deficiency. The elimination of carbon dioxide has also been so emphasized, that we forget that the retention of a certain amount is quite as vital to life as the absorption of oxygen; that the balance between these gases can not be disturbed for long either way without seriously jeoparding the health of the organism.

One other speculative condition will be mentioned. The pulmonary arteries going to the upper lobes approximate at the points of their branching off the continuation of the tangents of the curves of the two main divisions of the pulmonary artery, and are, therefore, more likely to be the pathways of any of the lighter particles in the blood stream. It may be that in the long run, owing to their less specific gravity, more leucocytes, relatively, pass through the upper lobes than through the lower lobes. Because of their wandering habits, many of these leucocytes have engulfed perhaps tubercle bacilli, and those that pass into the upper lobes are likely to be slowed down or arrested in the more or less collapsed capillaries of the apical regions from which they again wander, going into the interstitial spaces and air sacs, carrying in and depositing their contents, bacilli, carbon, etc., taken up by them elsewhere in their previous wanderings. As an observed fact, the upper lobes, and the upper part of the upper lobes, show usually the earliest and densest pigmentation. Bacteria free in the blood stream would be subject to the same reasoning.

If the assumption of the upright posture be really an etiologic factor in apical tuberculosis, it should be expected that animals habitually pronograde and such as are subject to tuberculosis should show analogous loci of infection; and this is found to be the case.

In 1804, Theobald Smith,[7] in studying tuberculosis in cattle, found in nineteen autopsies of dairy cows, slaughtered because giving positive reactions to tuberculin, that the earliest evidence of the pulmonary disease was manifested quite regularly in the caudal lobes, and "in that portion of the lung tissue above or dorsad to the main bronchus, *i.e.*, in that portion of the lung tissue which rests under the ribs at their vertebral attachment." This region corresponds physically with the apex of the human lung, that is, it is the highest part of the lung in the standing position of the animal. It is also the highest part of the lung when the animal is lying down, differing in this respect from the

apex of the human lung. However, the caudal lobes were not exclusively the ones affected. Smith tabulated his findings as follows:

"The large caudal lobes were affected in 16
They were affected exclusively in 11
Both caudal lobes were affected in 6
Left caudal lobe alone in 5
Right caudal lobe alone in 5
Right cephalic lobe affected in 6
Right cephalic lobe affected exclusively in 3
Left ventral lobe (with other lobes) in 1
Right ventral lobe (with other lobes) in 1
Left cephalic lobe (with other lobes) in ..... 1."

It is particularly significant in this tabulation to notice that the ventral lobes were affected but twice, and not exclusively but in association with other lobes. Now the ventral lobes are the lowest parts of the bovine lungs, and in this respect are physically analogous to the basal lobes of the human being. Another interesting and relevant contrast indirectly brought out by the foregoing tabulation is that of the functional movements of the lungs of orthograde and of pronograde animals: The apex, the most frequent locus of incipient pulmonary tuberculosis in human beings, is the least mobile portion of the human lung; the caudal lobe, the most frequent seat of incipient pulmonary tuberculosis in the susceptible pronograde animal, is the most mobile portion of the pronograde animal's lung. The frequency of the caudal lobe as the seat of incipient pulmonary tuberculosis in animals has been observed by so many observers that we must accept the fact as established as firmly as that of the apex of the human lung.

It is relevant and significant to note, also, that Campbell,[2] in 1891, as a result of his post-mortems on animals of the Zoölogical Gardens, London, was struck with the similarity of tuberculosis in monkeys to that of young children. Campbell was particular in stating that the age of the monkey had no apparent effect on the tubercular manifestation, it was the same in both

old and young animals. He also stated that he "was struck by the fact that the apices" of monkeys' lungs, "instead of being more liable to the disease than other parts of the lung, are as a rule less affected." I think it will be admitted that the postural habits of monkeys and young children are not very far apart. This similarity of tubercular manifestation in the young child and in the monkey lends, at least, additional color to the influence of posture as set forth herein. Certain of the current and approved therapeutic practices seem also to give plausibility to this hypothesis, and at the same time to receive from it a certain degree of physiological assurance of their own wisdom.

Recumbent rest is admittedly beneficial in the early and active stages of pulmonary tuberculosis, and exercise, in those stages in which the disease processes are nearing cure or passing into a condition of chronicity. In recumbent rest, the diseased apical regions are absolutely more hyperemic; a large part of the blood from the previously overfilled and larger lower lobes being returned to them by hydrostatic pressure, and whatever defensive and offensive properties may be present in the blood, either naturally inherent or physiologically acquired, are brought into action at the seat of the disease. As long as recumbency is maintained the therapeutic effects of these properties are at a maximum and, if equal or superior to the power of the invading germs, stay or cure the disease, as the case may be. In exercise, the demand for more blood in the muscles leads to its expulsion from the great vascular reservoirs of the abdomen, the liver, the spleen, and the intestinal vessels and capillaries. This additional volume of blood must pass through the pulmonary circulation, and it must continue to pass through as long as the exercise is kept up. As a result the vascular spaces of the lungs are better filled and the diseased areas more or less flooded by this increased quantity of blood in the lungs.

In conclusion, it is right to state that I have found in the literature a number of allusions to the difference of the circulation in the apical regions as compared with the lower regions of

the lungs and as incidental to the assumption of the upright posture; also as to the upright posture being a factor in the etiology of apical tuberculosis. But so far, I have not come cross any statement connecting the upright posture in just the manner I have herein suggested. However the literature is so extensive that I have to plead the want of time to examine more of it than I have.

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CARDIO-VASCULAR-RENAL REGULATION.

Remarks on Certain Practical Bio-kinetic Devices or Processes Useful for the Conservation and Reconstruction of Cardiopathic Patients.

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No greater welfare service could be rendered to human-kind than to popularize the leading facts about prevention, relief and rational cure of diseases of the heart and its associated structures, and especially of their effects. Attention can be directed here to only a few of the more graphic points and resources, leaving to better men the task of carrying on. It is of prime importance for the public and the profession to realize how much radical help can be afforded in both prevention and restoration by means other than drugs, by agencies applied to the exterior as well as by wisely regulated conduct—all of which can be done in full harmony with one's ordinary scheme of life, likewise entirely agreeable. To master this one department of physical welfare will go far toward making the largest contribution of life, liberty and the confident pursuit of happiness.

The maintenance of health and often of life rests squarely on the integrity of this one group of organs, heart, blood vessels, and kidneys, with their immediate correlates, the digestive, metabolic, and respiratory group. They can be kept in order by the simplest and sanest of precautions and self regulations. When death does occur, no matter what be the outstanding malady, it is due to giving way of weak spots in the cardio-vascular cycle. Hence, while conservative measures and rational

procedures are usually sufficient, proper medicines may be, and often are, required but only when early and essential precautions have been omitted. Their use at any time becomes a mere stop gap.

The fact is that diseases of the heart and vessels have been shown statistically to be steadily on the increase in the United States,* while this proportion is lessening in the older communities. We assuredly need arousing to the urgency of greater precautions. We are facing here the crux of human economies.

Most intelligent people, as well as many physicians, still regard the blood pump and its distributing channels as capable of taking care of themselves, as needing no direction until something serious happens to impair their integrity. This may be a partial truth, but much more is needed, and can be readily impressed upon the patient by any competent clinician.

Just so soon as mankind, including some older members of the profession, come to visualize the circulatory cycle in full perspective, mortality statistics can be reduced materially. The poet creates a gloomy view who states that "our hearts like muffled drums are beating funeral marches to the grave."

Mankind is so constituted as rather to welcome destruction than to undergo the exertion of substituting a rational for a symbolic or rankly optimistic or a *laissez aller* view. Many prefer to "acquire merit" by disregarding perils and thus fulfill the law of Mother Eddy and "leap before they look," as Richard C. Cabot says.

Fortunately some sense of caution comes at or near the halfway house of life, when perils to circulation most commonly arise. At that epoch there is demanded the pursuit of *vigilant personal hygiene.* When actual danger signals are inferred or estimated, there is no warranty for despair. All that is needed is a more rational revision of behavior, the formation of conser-

*The mortality statistics for 1917 (Census Bureau) state: In registration area of Continental U. S., rate per 100.000: Heart diseases (1st), 153; Bright's disease and nephritis (4th), 107.4; arterial diseases (8th), 79.

vative habits whereby confidence shall be established, also mutual compacts and their observances.

Useful Agencies (Bio-kinetic) for Influencing blood and Lymph Profulsion, Hence Cardio-vascular Stabilization.

The worst leaks in survival values occur through damage to the blood vascular system. Any or all agencies capable of checking or stopping these leaks should be faithfully tried out, scrutinized, verified and applied promptly and consistently. Open-mined attention to promising remedies is an index of common sense. The final test is experience.

The resources of medication, large as they are, must have limitations. These limitations in grave exigencies impress us with a despairing sense of inadequacy. Moreover, instances are met of vast harm wrought by lack of wisdom in the manner of their use. This harm is occasionally fatal. Fatalities from medication are, however, not confined to misuse, but to fatuous confidence in them which fails to be justified.

Inadequate dosage is often the death sentence. Throw a rope to a drowning man but let the rope be stronger than a 9 ounce amer thread or he perishes with it in his hand.

Never did this scientific groping so impress me as during the recent epidemic of influenza. I was guilty myself. The guilt of others, however, struck me often with even greater force. Perhaps the fatal cases were hopeless when met. Perhaps we groped in a slough of ignorance. A larger proportion died than was justified. Not one swallow, nor one thousand swallows, makes a summer, but when a clinician succeeds by luck in having a far lower mortality than his colleagues, he is to be pardoned for inferring his methods had merit.

In justifying confidence in the measures here advocated, let me cite in evidence the fact that while I used much the same heart medicines, though in colossal doses, as the best colleagues, my own taste was for relying on every rational, (physical or bio-kinetic) instrumentality which promised to fortify the individual, as well as do the utmost to combat the disease by drugs.

Whereas sharing equally with most of these colleagues, grave doubts as to the efficacy of some standard drugs in fullest dosage, also graver doubts as to the by-effects of those drugs, I am absolutely certain that the remedial procedures, reconstructive or bio-kinetic measures employed, did no harm if they perchance did no good. So much for squaring the account with my conscience.

I postulate that: in striving to accomplish equilibration of the regulative energies in the cardio-vascular cycle, vastly greater safety resides in agencies exerted from outside, by attempts at influencing reflex response, vaso-construction, also eliciting vagogenic and sympathetic helpfulness, readily applied and released, than by introducing drugs into the economy which may keep on doing what they should not do, or fail to do what faith in the power of the unseen hopes they will do but don't.

I postulate further that: in the face of failures of drugs admitted candidly by such men as Victor H. Vaughan and a host of other authorities who relied largely on medication, or serum therapy, it is our duty to turn our attention to bio-kinetic regulation applied upon the organism from without.

Matters of common procedure, notably those implicated in legend, in symbolism, in ancient authority, in the common experience of domestic gropings, in short home remedies, good nursing and the like, however fortified by experience but not by scientific studies, are proverbially those which least attract research workers. About them cluster, therefore, the widest divergencies of opinion as to principles of action, inducing cloudiness as to their force, fullness or efficacy, hence a disproportion of confidence fading off into preferential beliefs.

Those facts of which every one is cognizant remain in a state of perpetual flux, with currents setting from anywhere to nowhere.

I further postulate that when these humble, seemingly simple and inadequate doings, efforts at stabilization, through bio-kinetic instrumentalities, shall be scrutinized with the same

thoroughness and scientific zeal as are the givings of the pharmacodynamists, we shall succeed better and our patients survive longer.

Cardio-vascular-renal propositions are *au fond*, significant instances of bio-hydraulic equilibration. Until we get this concept firmly planted in the student's mind he is in danger of cherishing disproportionate confidence in the so-called "physiologic action" of drugs to the exclusion of the equally significant physiogenic factors in the problem based on bio-physics, not only cardio-vascular-renal disorders *per se*, but the nutrition of those structures and also of the nutrition, metabolism, of correlated structures, and of the organism as a totality contributory to reflex stabilization.

One factor impressing me as deeply significant is the function of the vaso-vasorum. Deteriorations of, or beginnings of degeneration in, the arterial walls must depend, in great measure, upon functional competence in these nutrient vessels of the vessels. An important item in nutrition of the arterial trunks is normality of the elasticity, pliancy and adequate functioning of the muscle masses, described by some physiologists as "the great oxygenating laboratories." Action, reaction, and interaction of the neuromuscular mechanisms conditions the integrity of the circulatory fluids, of the cells, and hence of all the finer processes of metabolism. Whatever helps action of the nutrient vessels of the vessels, makes for the nutrition of the structures of these arteries.

Hence the first desideratum (in subacute or chronic disabilities or disorders or their effects) is completeness, or adequacy of muscular action, active or passive. Upon the adequate functioning of the muscles depends those needful compressions and relaxations of the arteries whereby suction and expression is exerted upon the vaso-vasorum. How otherwise can these minute and yet highly important organs escape deterioration?

The effects desired are thus enhanced, or at least ample distribution of nutrient fluids and their return is secured; also

adequate flow maintained through the organs of elimination. Where there occur stagnations, congestions, waterlogging in localized areas, something more is often needed than can be achieved by amplifying interaction by means of medicaments, even of preparations of those most influential principles the blood glandular or hemadenogenic organs.*

Among the regulative agencies exerted from without, and helpful in restoring hydrostatic equilibrium, are coarser movements, muscular actions, and the finer aggregations of applied motion, passive or made upon the subject, in their diversified manifestations (bio-kinetics), and among the means available are these:

Pressure, compression and relaxation, the natural full action of muscle masses upon tubular and spherical organs and structures: also the respiratory mechanisms, the lungs through their moveable structures, diaphragm and external muscles and the like. Also consciously performed, regulated breathing acts thus often prove of definite efficacy.

Likewise the *artificial* and *extraneous* compressions and relaxation (manual, manipulative and other) whereby pumping action, current flow, is expedited by acts done upon the parts.

Also particularized pressures, compressions, concussions, and other agencies for eliciting fuller *reflex action and reaction*, such as can conveniently and compellingly influence the spinal vasomotor, vagogenic reflex arcs, etc., exerted upon areas adjoining nerve centers, subcenters, paravertebral structures, at or near points of exit, of *rami communicantes*, also nerves in continuity. This subject has been elaborated carefully by Albert Abrams.

These reflex effects, reflexo-genic influences, are capable of being exerted satisfactorily by the simplest of agencies, the hand, the finger tips alone, or one reinforcing the other, by suction, by impacts, by concussion, by a mallet upon a mass of firm rubber

* For a masterly presentation of "The Effects of Exercise on the Blood," see P. B. Hawk, *Am. Jour. Physiology*, Vol. X, p. 384; also Sneider and Haven, *ibid.*, Vol. X, p. 239, 1915.

(like an eraser) exerting powerful and controllable push and pull phenomena; also by posture, attitude, gravity, by belts, corsets, rubber tissue, Z. O. plaster straps; likewise by thermogenic agencies, heat and cold, local or general, muscular movement to the point of "warming up," and by rest, by skin friction, subdermal traction exerted at the point of induced hyperemia, by encircling bands, etc.; also by colon irrigations, by venesection, by centrifugation of fingers (whirling the arms).

Among reliable thermogenic devices are remedial baths, hydrotherapy, packs, hot and cold compresses. Turkish baths (dry heat), Russian baths (steam heat). The superheated dry air devices of Tyrnnauer, up to 300° F. Electric light cabinets. Violet ray, Alpine sun lamps (the Negelschmidt or Kromyer quartz lamps).

Cold deserves much attention, especially cold and wet compresses. Dry cold is capable of checking abscess formation, is a means of retarding pus, and various disorders of stagnation or local injury.

An efficient and reliable field of relief and cure not yet systematized is that of pressures exerted on the paravertebral tissues by finger tips whereby vasomotor and viscero-motor effects are induced (through vaso-constriction chiefly.) Various movements elicit gravity and muscular and hydraulic compression, *i. e.*,attitude (or postures) to induce changes in interrelationships of viscera and blood vessels, as Trendelenburg and Fowler positions, knee-chest posture, head hanging to check hemorrhage or to empty bronchi, and centrifugation by whirling the arms to induce hyperemia in fingers by driving blood to finger tips. Certain attitudes and special movements induce compressing action between internal and external muscles, *e.g.*, psoas and abdominal parieties in enteroptosis, stagnation, prostatism, etc.

Regulated or educational exercises, passive, active, and free, accomplish good results by activating the pumping action of the heart and muscle masses. Belts are also useful here to constrict splanchnic bloodvessels, to induce counter-pressure, hence blood

distribution; also to arrest hemorrhage, *e.g.*, Momberg's, Longstreth's, Kilmer's, Dawbarn's, Achilles Rose's, etc.; also the familiar tourniquet, or rubber bandage, or encircling tube, (*e.g.*, constriction of the neck in seasickness by an elastic band with hooks and eyes around the neck). Rhythmic compression of the heart in apparently moribund states, is an important mechanical life-saving agency. Resting the veins by raising the legs higher than the hips.

In cases of high fever, of cerebral excitement, when fear, or antagonism to cold water exists, use a sprinkler with tepid water on the back, the patient lying face down. Begin with warm water, 85° to 100° F., and gradually cool to 75° to 70°. This will rouse from stupor or allay delirium, is also of great value in distresses accompanying many chronic states, high blood pressure, arthritides, gouty exacerbations, stagnations and other disturbances of metabolic equilibrium. Alternate hot and cold douches with greater force of impact from a hose or tube in a warm bathroom are useful to stimulate sluggish local circulation. Colon irrigation is a hydrotherapeutic and vascular regulative of great use to unload the bowels of putrefactive matter and toxic mucus. And also as an emphatic diuretic.* The temperature should be below that of the body, about 90° to 80°, to induce evacuations; to soothe spasm it should be hot, 105° to 120°; to induce diuresis any temperature will do, the best being cool, 80° to 75°. All are useful in fevers, acute internal diseases, cardiovascular renal diseases, arthritis deformans, acne vulgaris, pruritus ani, eczema of the rectal surfaces, etc.

Superheated air is of wide applicability (*vide* Tyrnnauer), though less used than it should be. This is true also of induced or reflected heat from electric lights, white and blue; also "leucodescent lamps." Less well known are the effects of centrifugation, or whirling the arms to drive blood forcefully to the finger tips and joints of hand and wrist. This is my own device, and it is found most useful to enhance sluggish circulation in the ex-

*See Martin H. Fisher's "Alkaline Irrigation for Nephritis," etc.

tremities; to enhance phagocytosis in gouty joints, in local inflammations, septic and other; to relieve interphalangeal rigidities and to aid in cure of angiotropho-neuroses, "wax finger," Raynaud's disease, effects of trench foot. Skin friction and traction compels surface distribution of blood.

Venesection is particularly useful in uremia, coma, and vascular overtension, and when the blood is vitiated and viscous as in cerebral hemorrhage. Local freezing (Albert Abrams) over spinal centers forcefully affects disorders of the spinal centers shown at periphery. In neuritis of the arms, spasm, pain from fibromyositis, and in herpes zoster, freeze over the fourth and fifth thoracic vertebræ. Concussion on certain points, as the seventh cervical or other vertebræ, enhancing or depressing vagus tone is most valuable in a variety of conditions of loss of vagotonicity, notably in aneurysm of arch of the aorta, angina pectoris, exophthalmic goitre, etc.*

Let me cite an impressive experience. A vigorous gentleman of 75 years came to my office about twenty years ago, who manufactured and sold a "kidney belt." He told me he had cured himself of chronic Bright's disease, citing his physicians and history. He accepted only clients who could prove they were real renal victims. The price was $300.00, but unless the owner obligated himself to carry out the instructions, he was penalized by "having the belt taken away."

These instructions consisted of excellent minute supplemental measures (bio-kinetic), among which were vigorous dry skin friction, on rising and retiring, not less than half an hour at a time, to be followed by inunctions of olive oil. He also sold them the brush and the oil. Likewise he insisted upon a particularized dietary, and certain exercises, chiefly to achieve pliancy, uniformity and completeness of all normal movements.

Several of his patients came to me for varied reasons. They were mostly middle aged or elderly nephropathics. The condition of their skin was really remarkable for tone, color, elas-

*See Abrams' book, "Spondylotheraphy."

ticity and temperature. Let me urge that such sound and effective instructions be imitated.

The chief reasons for or explanation of induced reactions on circulation are somewhat thus:

Every mechanical stimulus awakens reactions on the circulatory mechanisms. In health, or in one not extensively disturbed or deranged, reactions to stimuli are promptly followed by equilibrium and no harm is done. When the organism as a whole is thrown out of gear, one or more of the local regulative nervous mechanisms fail to do their full duty.

It is a matter of common knowledge that it is entirely possible to stimulate the periphery so as to aid in regulating the disturbed circulatory mechanisms—*e.g.*, the effects of a mustard plaster.* Also the familiar effects of heat, of cold, of rest, of impacts, etc. It is equally well established, but not so commonly realized and only rarely employed, that when the right sorts of stimuli are applied to or near subcenters, as over the plexuses, or over the nerves in continuity, effects can be produced, actions enhanced, in accord with function and in directions desired.

"An Important Factor in Circulation," the title of an article by the late Achilles Rose (April 20, 1911, New York Academy of Medicine) consists of the mechanical forces of the body which distribute blood and other fluids; (*a*) as blood and lymph in vessels; (*b*) as tissue juices, and (*c*) in constituting the most important part of the cells. A common feature is that they may be mechanically dilated or compressed and that they are also dilated and compressed of their own force. The task of moving water devolves upon the heart, hence the need to meet this by adjusting the resistance. In order to equalize gravity the *nervi irrigentes* come into play. They dilate the veins, creating vascular dilatation and thus induce a vacuum, hence cause suction. The heart thus acts as a suction pump through hydraulic action through the veins. He emphasizes the fact that relaxed tissues absorb fluid more readily, hence the efficacy of abdominal support by belts, and the like.

* *Vide* Sir Lauder Brunton "Pharmacology."

Summary.

The objective considered in repairing cardio-vascular-renal disorder and so much of the structures involved as are remediable, is to restore equilibrium in regulative forces acting within through application of suitable agencies from without.

The possibilities are of the best provided the enterprise is begun early enough. This, however, being seldom practicable, the probabilities are vastly better at any period than is generally appreciated. Hence the value of visualizing them, of surveying our resources frequently, of making use of those applicable in the instance, and of faithfully appraising our experience.

No one has a right to condemn, deprecate or deny efficacy to reputable measures until he has honestly and adequately subjected them to fair trial under fair conditions. In the immediate future much revision of bio-kinetic therapeutic measures must come about, and to the vast advantage of medical potential. The process under consideration includes the education of the creature to adapt itself not only to the ordinary exigencies of environment, to varied stimuli or irritations, but especially to recover poise after encountering extraordinary exigencies, new, strange, even adverse situations.

The mechanisms notably involved are the reflexes, the spinal, sympathetic, vegetative, autonomic in all their complex implications and means whereby they can be utilized in the process of readjustment and stabilization. Also the great regulators of these, the ductless or blood (hemadogenic or endocrine) glands which, as Sajous has so clearly and convincingly demonstrated, play the major rôle in stabilization, in particular of the blood, blood vessels, lymph channels and their contents.

The elemental forces acting from within, which are thus subject to influences exerted from without are, first of all, motion and heat, thermodynamics and motor-dynamics in the form of bio-kinetics. Of these bio-kinetic means or agencies we have presented memoranda of some of the more usable or applicable forms.

We may then pass in review a crude schema of manifestations of cellular energies thus:

1. *Psychodynamics*, the "power of thought," the "primal urge," elan vital, or as the Fruedians delight to call the whole push "libido," phases of which may be categorized as the affective functions, behavior, feelings, emotions, promptings, trends, tropisms and the like phases, all of which must be reckoned with as factors in cardio-vascular equilibration. Fear, anxiety, worry, doubt, self pity, forms the crux of most diseases of mind and also of body as Boris Sidis has convincingly shown in his book, "Causation and Treatment of Psychopathic Maladies," 1916.

Every clinician is, at least, aware of the subtlety and surprisingness of emotionalism as a factor in disorder or repair. Moreover, unless he learns to inculcate and guide the factors of conscious control, either the case remains *in statu quo ante* or passes from bad to worse, and by reason of this factor alone no matter what cunning combination of drugs is invoked.

2. *Physico-dynamics* or bio-kinetics, the potentialities which reside in, and are manifested by physics, from ponderability, gravity, hydraulics, pneumatics, thermogenics, photogenics, electrogenics, all the way to the simplest adaptations. Here we have the familiar but too often unclearly comprehended domain of heat and cold, actuation and inhibition, the "changing play of light and shade," of color, odor, taste, or attraction, repulsion, and the innumerable stimuli or stresses or overbalancing instrumentalities of environment.

Within this gambit are many bio-kinetic resources, some admirably elaborated and some as yet only inferred or hoped for, but which will evolve. Under photodynamics we need merely mention a few potentialities lying chiefly among direct sunlight (heliotherapy), electrodynamics, especially the violet rays, which are equivalent to filtered or modified sun rays.

Under pondero-dynamics we may include all such forces as have to do causally with weight, either as a cause for harm, *e.g.*,

drag, strain direct and indirect, also torsion of arterial trunks or of limbs, etc. Also traction, suspension or the converse support, release of pull, traction or torsion or relief from compression of weight, *e.g.*, fluids in over-relaxed intestines or compressions exerted for a physiologic purpose, *e.g.*, Biers' method of compression of arterial trunks; also suction hyperemia; also support, by apparatus, belts, cuirasses, to raise the abdominal contents, to aid splanchnic circulation, and to hold them in favorable conditions for functioning; also posture (or rather attitude) carefully adjusted, *e.g.*, Trendelenberg, head hanging, "resting the veins" of the legs by raising the feet an inch or two or a foot or two, higher than the buttocks, etc. Dr. Morris Longstreth devised and used with immense success a belt I have described and used for 25 years.

Motordynamics, motion, movement in its varied manifestations, (bio-kinetics), in its positive or negative phases, or actuation versus inhibition, stabilization through alternations of push and pull, movement and rest.

Active movements, myogenic equilibration, muscle training, particularized modifications of, training of structures so as to assume more advantageous attitude or posture, *e.g.*, of the back, neck, abdominal muscles, thoracic muscles, diaphragm. Active elasticizing and full stretchings, training of normal movements to reach (extend) or withdraw (flex) or turn (torsion) in all directions in accord with design or function.

Passive movements (negative motor phases) exerted upon a part from without, by an instrument or by an operation, by bending, straightening, forced flexions or extensions or torsions, pulling or pushing, exerting compression, also:

Resisted movements, part passive and part active, by alternations of extension-flexion and of flexion-extension, by graduated tension and relaxation, finally the whole extensive and elaborate subject of:

Massage—manipulation—manutherapy. From mere hand squeezings and relaxation, to artistic moulding, separation,

pressure, thrusts single and double, *e.g.*, in a direct line or exerting modified fulcrum action as of a part supported using force at two opposite points, the leverage action of a long bone in its socket or on intra-articular pressure to release tonic spasm adhesions, rigidities, stiffness to secure elasticity and thereby place minor blood and lymph vessels in favorable positions for ebb and flow of fluids.

Elicitation of the reflexes, activating reflex responses, especially such as induce effects on vasomotor balance or imbalance, a very efficient means of expediting arterial contraction and relaxation, hence nutrition and elimination, general or local. Also making use of the spinal reflexes, the sympathetic, vegetative or autonomic, the major effects obtainable or those wherein mechanical stimulation of areas influence nerve centers and sub-centers bearing on vasomotor, or vagotony or sympathectony; also indirectly on the nutrition of cell bodies at the interdiscal cord levels.*

Particularized Personal Hygiene.

Among the more familiar or particularly applicable items are: Diet, mastication, selection, association of foods; likewise elimination, economic attitudes in defecation, skin care, dry friction to whole dermal surface tenderly, subdermal traction, etc.; clothing, etc.; judicious activities and rest, etc.

A Seldom Recognized Cause of High Blood Pressure.

Edgar F. Cyriax, of London,† says that among the various conditions which have been accepted as causes of high blood pressure, we search in vain for mention of one which is very common, namely, irritative states of the erector spinæ. (In this communication the term erector spinæ will be taken as including the dorsal extensors from sacrum to occiput.)

* See Sir Lauder Brunton's explanation of the effects of a mustard plaster, "Text Book on Therapeutics," also laboratory findings of John P. Arnold Also addendum to this paper, Memoranda, Mr. Edgar F. Cyriax, Practitioner, November, 1917.

† *Practitioner*, November., 1917.

Of these irritative states, there are three chief groups:

(*a*) Hypertonus.

(*b*) Diffuse fibrosis or fibrositis.

(*c*) Venous congestion.

All of which may exist with various degrees of intensity, either locally or generally, alone or in combination.

The diagnosis of these conditions is not difficult when they are looked for and especially when palpated for:

(*a*) Cervical hypertonus, if at all pronounced, is quite obvious since it produces the short thick neck which for centuries has been associated with apoplectic tendencies. Pathological increase in the normal curve forwards in the lower cervical region is often met with, and is doubtless the result of the persistent muscular contraction. Hypertonus in the dorsal and lumbar regions is not so obvious. With the patient lying on his face, there should, normally, be no difficulty in relaxing the extensor muscles of the back, but in hypertonus this is often impossible or very difficult. If the patient is able to effect this relaxation, the slightest stimulus, such as a mere touch, will immediately induce a continued powerful contraction of the muscles mentioned.

Changes in the normal curves of the back may be found, a common example is lumbar lordosis.

(*b*) Diffuse fibrosis or fibrositis is a frequent cause of so-called "rigid back," a condition whose importance has been greatly underestimated, for it is a potent cause, either primary or secondary, of disease. Its chief characteristics are limitation of movement, pain on attempting to move, and diffuse tenderness in the erector spinæ. Also the well known nodular thickenings of the neck which are the cause of "muscular headache." These thickenings are readily defined by ordinary deep palpation.

(*c*) Venous congestion, although usually only an accompaniment of (*a*) and (*b*), may exist alone, and is often associated with a slight degree of edema. The commonest site for local edema is around the seventh cervical and first dorsal vertebræ, where a

circumscribed swollen area may be found, boggy to the touch and not infrequently showing radiating lines of small congested blood vessels.

The methods by which these irritative states induce elevation of the blood pressure is not difficult to trace. It is by means of a continued series of sensory stimuli to the posterior spinal nerves, in other words, by a never ending series of pressor effects. If Nature is unable to compensate for these as they arise, an increase in the blood pressure is the result.

As regards the actual exciting cause of the irritative states of the erector spinae, there is one important group, which up to the present seems to have escaped recognition, *i.e.*, anomalies of the vertebræ either as regards articulation or position. Synovitis of the vertebral joints, especially the cervical, is much commoner than generally supposed, and so, too, are apparent malpositions of the bones, which in their turn necessarily involve similar anomalies as regards their cartilages; slight multiple adhesions are frequent. The reason why these vertebral adhesions and synovitis are so common in the neck is, to a large extent, due to the fact that one is so seldom called upon to exercise the cervical muscles against resistance. The pathology of joint trouble from insufficient use holds good for the spinal column just as for articulations elsewhere.

From the practical point of view, the identification of the above-mentioned causes of high blood pressure is of considerable importance. All treatment must be directed towards removal of the cause of disease, especially that described as "mobilization of the spinal column." By this is meant active and passive movements of the vertebral joints, passive manipulations (vibrations petrissage, etc.) of the erector spinae, a suitable selection being made in each case.

Cyriax holds that if the cause of the elevation is partly or wholly to be found in irritative states of the erector spinæ, no mechano-therapeutic program is complete without appropriate trunk and neck movements.

A CASE OF ENLARGED THYMUS GLAND,

And Some Remarks on Status Lymphaticus.

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W. S., aged 20, 5 ft., 6 in. tall. Weight 145. A patient of Dr. William F. Grady, of Montclair, presented the following history and symptoms.

F. H. Negative.

P. H. Negative.

Present Condition.—Patient had always been well. No similar case known to have occurred in any member of his family immediate or remote. In the spring of 1917, patient undertook strenuous farm work near Greenwood Lake, N. J. Once after exhausting labor, he jumped into the lake when overheated. He swam a considerable distance. No immediate untoward effects were noticed. But in about two weeks he began to complain of lassitude and loss of muscular vigor with some dyspnœa. (His habits were good. No tobacco, no spirituous liquors, not addicted to venery—seems to have little libido sexualis. Is athletic and fond of outdoor sports.) Being unable to work, he returned to his home in Montclair. By this time his neck, upper chest and shoulders, especially the right, had begun to swell, with soft œdema. There were also a number of maculæ, dark purple in color, and about the circumference of a dime in clusters over the upper sternal region. These lasted about two weeks. The lower part of the cheeks and the neck looked like those of a person with a large goiter, although the swelling was more evenly distributed than in the average goiter case. The dyspnœa, loss of muscular tone, etc., gradually increased. The patient was taken to a prominent consultant in New York City. A loud double heart murmur had developed and the

patient seemed very sick. The consultant declined to make a positive diagnosis. There were no symptoms especially referable to the heart beyond those mentioned above. The throat and fauces were normal. No enlargement of the tonsils or increase in adenoid tissue. No fever nor chills. Appetite fair, less ravenous than usual. (Patient has always been a very hearty eater.) No glandular enlargements noted. No pain nor headache. Urine examined and found normal. No constipation nor œdema other than that mentioned. No sweats or tremors. Occasional tachycardia. Pulse usually about 60. The consultant thought there might be an aneurysm and advised an x-ray examination. This was made by Dr. Charles F. Baker, of Newark, who found the thymus gland so enlarged that it covered all or nearly all of the anterior surface of the pericardium. The patient received six x-ray treatments in all, at weekly intervals starting with 3x. and gradually increasing to about 10c. By this time the œdema had entirely disappeared. He resumed his previous habits as to various activities, dancing, playing baseball as well as basket and foot ball, swimming, etc. In about a year the œdema and dyspnœa returned. The x-ray treatment was resumed and the patient, after nine exposures, is now again free from œdema. He is taking 20x. and expects to take two more treatments. The patient, although he has carefully concealed the fact from his usual medical attendant, took a sharp run of about a mile to catch the last train two or three months ago. He made the distance on record time, but apparently brought on a recurrence of his former symptoms and both he and Dr. Baker believe that the imprudence in running (with perhaps a subsequent chill from riding in the cars when overheated and exhausted from the exertion, induced the recurrence of his former symptoms. The heart murmur, although milder than formerly, is still present. The boy's general condition seems good at this writing (September 1918).

Although there was improvement after the second series of x-ray exposures just alluded, this was only temporary.

The following extract from the records of Dr. Baker's office throws some light upon the condition, although it can not be positively asserted that the x-ray diagnosis of a tuberculous infection proves anything regarding the etiology of thymus over-growth.

Report of Roentgen Examination of W. S., June 29, 1918.—Two stereoscopic plates of the chest were made which show practically the same condition as the first two taken (some months ago). As regards the thymus, although I do not think the thymus shadow is quite as large as it was in the first set of pictures.

There is a distinct cloudiness of the left lung and the shadow of the bronchial in the apex (first and second interspaces) are clear to the periphery. In the lower portion of the upper right lobe, the shadows are very dense. All of which indicates that there has been an involvement of this lobe with tuberculosis.

A comparison of the last set of plates with the former also shows a slight degree of cloudiness and fibrous tissue deposit, but the former set of plates are not as good in this respect as the latter.

Summary.—The return of the œdema of the face seems to indicate that there should be more therapeutic x-ray treatments given and I would suggest a careful physical examination of the chest, temperature, etc., to determine if there be an active lesion of the left side at this time.

The patient gradually lost ground. Dr. Baker asserts that no lasting benefit followed the second series of x-ray exposures, nine in all, although great improvement, which it was hoped would be permanent, had followed the original six exposures. The patient seemed to have been unusually active during the extremely cold weather of the winter of 1917–18, which his attending physician thought was especially injurious to him. In the fall of 1918, after the over exertion in running for the train, previously mentioned, he began to have œdema again and the adverse symptoms already mentioned, especially

a gradual failing of strength. Two Wassermann tests were negative. He developed an aneurysm of the aortic arch with protrusion of the upper sternal region, and a distinct tracheal tug. Œdema of the feet and ankles and hands and wrists developed and excruciating pain of right arm and shoulder. He gradually became helpless. There was nothing abnormal found in his urine. There was marked onthorpnœa, so that a Fouler bed had to be used for him. In fact for the last two or three months of life, the patient had to be kept under constantly repeated doses of morphine. There was no œdema of face and no maculæ present as in the earlier part of his illness.

He died March 31, 1919, from rupture of the aortic aneurysm.

An autopsy could not be obtained.

A case as rare as this accentuated with such marked symptoms seems to the writer worthy of careful study.

At the risk of being wearisome it seems necessary to give somewhat in detail a résumé of the better known observations on the nature and functions of the thymus gland.

The weight of the gland at birth is given by various writers at from 13.75 gm. all the way down to one third or less of that figure. Howland,[1] from an examination of the glands of 495 patients under five years of age found the average weight to be from 4 to 6 gm.

Mayo and McGrath[2] make the very practical observation that inasmuch as the size of the normal gland varies within such wide limits, it is probable that with more exact knowledge "we shall be able to estimate the physiological value of the organ, not so much by its gross size or weight as by a scientific determination of its normal, subnormal or supranormal parenchymatous value." In this connection also we must not lose sight of the possibility of accidental involution from various causes.

Exactly what the thymus is meant to accomplish in the economy is largely a matter of conjecture. Sajous[19] has satisfied himself and some others that this gland is put in the body to manufacture the phosphorus needed in osseous formation.

Another explanation of the function of the gland is that it controls or regulates the deposit of lime in the bones. These are examples of the statements of the bolder spirits who are willing to risk their reputations in ascribing positive attributes to this illusive little organ.

In 1614 Felix Plater reported the first known case of alleged death from an enlarged thymus in an infant; and in 1659 Wharton[4] observed accidental thymus involution in animals after excessive exertion. In the case I am reporting if excessive exertion had any causative effect on the status of the gland it was probably that of evolution. After Wharton's discovery it was noted that chronic diseases and starvation quickly reduce not only the weight but the parenchymatous value of the thymus. And Rudberg[5] has noted the regeneration of the thymic elements after the gland had been exposed to the x-ray. Friendleben has stated that complete regeneration of the thymus can occur, as shown by animals overfed after nearly complete starvation.

Minute Anatomy.

The gland contains two types of cells; the reticular and the so-called thymic lymphocytes. The former are considered epithelial elements which result from a direct transformation of the primary thymic anlage, and during the entire existence of the organ maintain their epithelial character. The corpuscles of Hassall, which are small concentrically striated bodies peculiar to the thymus are to be considered as modified epithelial recticulum cells. The lymphocytes in the thymus have called forth much discussion into which we have no time to enter. Clinically they are of especial interest by reason of their susceptibility to change. It is these cells that are melted away, as it were, by the x-ray and presumably it is the regeneration or recreation of these cells which cause a regrowth of the thymus body. Eosinophiles have been found in the thymus of very young children. It is denied that these cells exist in the adult thymus, in men or animals. Pappenheimer[7] believes that the presence of these cells

designates a definite stage of secretory activity similar to that observed in the hypophysis and parathyroids. While Rudberg[5] observed after exposure to the x-rays that there was an invasion of pseudo-eosinophilic cells synchronously with the destruction of the small cells of the thymus.

Growth and Involution.

Here again many theories are advanced. Mayo and McGrath[1] say that lack of knowledge as to the importance of the thymus in later life is a source of confusion in the diagnosis of various altered conditions of the body. There are remnants of thymic tissue present in man even in old age. Just what their import may be is very doubtful. The older pathologists and anatomists regarded them as merely vestiginal as indeed they regarded the hypophysis and the pineal gland. Of course I do not refer to the mythological age of medicine when the last named gland was considered the residence of the human soul. It has also been stated that the thymus was "persistent" or hyperplastic in association with certain diseased conditions. McAuliff says: "The thymus, like the thyroid, does not seem to be so intimately connected with sexual characteristics, but does have some association, as it is persistent in eunuchs. Possibly like the pineal it has a limited prepuberal function. This is an aspect of the subject that demands further study.

Even the normal involution of the average thymus is still undetermined. Some good authors maintain that the principal growth in weight and function takes place between the first six months and the third year of life; while others assert that not until the tenth or fifteenth year is the highest point reached. Most investigators believe that thymic growth takes place in post-fœtal life; but when this growth reaches its acme and how long the gland is physiologically active is still uncertain. Hart[8] says in the case of physiological involution there is a genuine growth of fat tissue, which can yield at any time to a new formation of parenchymatous islands, while in the patho-

logic involution of the gland there is reactive connective tissue growth and sclerosing, which in all severe cases leave irreparable changes in the organ. Some observers, however, believe that the involution of the gland is due to a simple cirrhosis. The epithelial portion of the organ naturally proves the more resistant and is said to assume the active rôle of cirrhosis. Rudberg[5] has called attention to the regeneration of the thymic elements after exposure to the x-ray.

Physiology.

Here again the mountain has labored with rather insignificant results. Still certain valuable conclusions have been reached. It has been asserted that as an accelerator of the pulse and a depressor of the blood pressure the thymic extract (also the thyroid extract) act antagonistically to the extract of the chromaffin system and that an injection of the expressed juice of the thymus into animals may result fatally after causing a fall in blood pressure and the pulse rate. The thymus was removed from puppies on the tenth day of life with no apparent immediate results. There were growth and weight increase in both the puppies which had been treated and the controls; but the increase in the former was fatty instead of muscular. Their bones were soft, they were weak and listless. There was a decrease in intelligence. They ate what was set before them without discrimination. After three or four months they fell behind the controls in growth. Their bones grew softer, they suffered from spontaneous fractures and frequent convulsions and became finally completely idiotic and after six to fourteen months died in coma. At autopsy their brains were swollen and œdematous, bones undersized, soft and pliable with thick epiphyseal cartilages. Microscopically there was osteoporosis and cartilaginous over growth. Chemically the bones showed 32.34 per cent. of calcium while those of the controls showed 65 per cent. Similar results were noted in another experiment on puppies except there was less mental hebetude present. The

picture of thymipriva was typical and similar to advanced rickets and due as Matti[9] claims to the impaired capacity of the excessive new bony tissue to assimilate calcium. No correlation between the status of the blood and the thymic changes was observed in extra-uterine life. The physiologic decrease of the lymphocytes and the increase of the neutrophilic leukocytes occurred later than in the controls. After thymectomy there occurs a microscopic and macroscopic hyperthrophy of the intrasuprarenal part of the chromaffin system, with indications that the process is correlative with the loss of the thymus. The thyroid showed slight increase in weight. There seemed to be a reciprocal relation between the thymus and spleen. The hypophysis appeared to be relatively larger although it was small in the stage of cachexia. The liver and pancreas were apparently enlarged. These experiments seem to show conclusively that the thymus is not a superfluous organ in growing dogs. In some cases compensatory activity of the related organs and the accessory thymic lobes may prevent the occurrence of symptoms after thymectomy. It seems to be established that the thymus, thyroid and parathyroids are closely related in function. Bourneville[10] noted the absence of the thymus in 25 out of 28 mentally defective children. Other experiments on dogs show that thymectomies to adult animals are without obvious effects and the assumption that the thymus and the chromaffin system are antagonistic in function seems at least plausible. The former inhibits, the latter excites the sympathetic nervous system.

Popper[11] assumes that the thymic extract influences clot-formation and should be taken into account in considering vascular thrombosis as a possible cause of cardiac weakness and sudden death in cases of hyperthymization, whether occurring in men or animals.

Wiesel[12] remarks that the contention that the signs of hyperthymization are rather due to resorption than to specific intoxication should be received with great consideration.

Pathology.

Many causes for pathological thymic conditions have been noted, the gland may be congenitally absent; certain of the changes observed in it may have been post mortal; while the infectious diseases of children, over-exertion and starvation, as already noted, may obliterate it, as well as circulatory diseases, acute inflammations, syphilis, tuberculosis and neoplasms. Frequently after death the parenchyma may be found hollowed out, which is alleged to be due to autolysis caused by the proteolytic thymic ferment, as demonstrated by Kutscher.[13] It is held that a strictly normal thymus is rare in the human body. Many of the older autopsies were inconclusive owing to lack of proper microscopic confirmation of the gross anatomy. Hemorrhages in the thymic body are not rare. A man who died suddenly three weeks after castration, had a clot in the thymus. Small hemorrhages have been found in the gland of the new born due probably to difficult labor. The infections, phosphorus poisoning, hemophilia and so on have been given as the cause of thymic hemorrhage. Three to four per cent. of 350 autopsies showed syphilitic infection of the thymus. It is claimed that syphilitic infection of the thymus may be the sole manifestation of the disease. Primary tuberculosis of the gland does occur, but this lesion is usually secondary to tuberculosis of the bronchial glands, general miliary tuberculosis, or caseous pneumonia. The tubercle bacilli have been found in the thymic tissues. The condition is not generally recognized during life. New growths of various sorts have been found in the thymus. Cysts of the gland have been found in normal as well as in pathologic conditions.

Status Lympathicus.

Richardson[20] says that in most cases when there is marasmus or a condition of malnutrition, the thymus gland is quite small. Conversely most of the status lympathicus cases are fairly well nourished.

Of the large number of infants dying suddenly, sometimes with and sometimes without one or more preliminary suffocative attacks, many at least must have succumbed to pressure especially upon the trachea, which has been found flattened at different levels. There has also been pressure upon the innominate vessels, where these cross the trachea. The bronchi have also been found flattened and atrophy of the cartilaginous tracheal rings from pressure has been noted. Extension of the head and neck naturally tends to increase the dyspnœa. Mayo[1] reports two successful operations for relief of thymic pressure. In one case he only removed the right lobe, in the other, one half of this lobe which weighed ten grams. Death from thymic pressure is strenuously denied by some, one observer asserts that in 2,341 postmortem examinations of children 83.1 per cent. of whom were nurslings under one year of age, not one death could be fairly attributed to thymic pressure. Dysphagia from pressure on the œsophagus has been noted. While the cause of so-called thymic death, not to mention asthma, tetany, laryngismus stridulus and other suffocative manifestations formerly attributed to thymic enlargement, has not been definitely settled it would appear that those who deny the causative connection of pressure in toto, are taking too strong ground. Mayo and McGrath[1] say that the gland can act in a mechanical way in causing severe disturbance, while they admit that sudden death solely from enlargement of the thymus is extremely rare and of course the condition that is presumed to have caused the thymic hyperplasia has no doubt predisposed the affected person to sudden cardiac or suffocative dissolution. Yet considering the favorable results of the few cases of thymectomy in children reported (and there seem to be less than a dozen of them) it must be admitted that there is a good deal to be said in favor of the operation and the relief of pressure. When the Mayos can point to one or two thousand thymectomies, done in their own clinic, as they pointed some years ago to 5,000 thyroidectomies done in that famous clinic; they will no doubt be able to give us

something definite regarding the thymus, its functions and its diseases. What seems necessary at the present writing is more bedside and operative work. Nor is this the only hitherto unsolved problem in medicine that can not be brought to a clear and demonstrable solution without a conjunction of the great forces of clinical, laboratory and pathological workers, now, alas! working usually quite independently and sometimes, at least, unable to judge of their own limitations.

In many sudden deaths, where there was no apparent cause, and also in some seriously diseased conditions, an enlarged, persistent thymus has been observed either alone or coexisting with certain abnormal conditions in the lymphatic system and other bodily organs. These changes as a whole were originally grouped together under the title of status lymphaticus but recent observers have subdivided this syndrome into three subdivisions as follows: status thymicus, status thymicolymphaticus and status lymphaticus. These three conditions are so named according to the size and the apparent activity of the thymus. The status thymicus has already been briefly discussed. In it the size of the thymus is usually larger than in status thymicolymphaticus and is not accompanied by marked changes in the lymphatic system. In the status thymicolymphaticus there is a general hyperplasia of the lymphatic tissues throughout the body, especially the tonsils and the lingual, pharyngeal and cervical glands. While in the status lymphaticus, the thymus is not enlarged and may even be subnormal in size, nevertheless the size of this organ is probably not of itself a criterion of the systemic lesions present in these three allied conditions. Most of the cases of so-called thymic death occurred in adults; but some have happened in infancy and early life and probably some of them were not attributed to the right cause. Among the conditions under which these sudden deaths have occurred were bathing, general and local anæsthesia, operations (often trivial), flogging, coitus, mental excitement, ordinary walking and even rest.

Among the diseases having a more or less close relation to the thymic and general bodily conditions under discussion are exophthalmic goiter, Addison's disease, diptheria, tetanus, eclampsia, eczema in children, myasthenia, osteomalacia, burns, etc. Bartels[21] reports that in 122 cases of suicide 36 per cent. were cases of status thymicolymphaticus; 26 per cent. status lymphaticus and in 20 per cent. there were some signs of lymphatism. Diphtheria as noted above, is one of the diseases quite often associated with lymphatism. Most cases of tetanus and a number of cases of eclampsia in females are associated with status thymicolymphaticus. Uhlenhuth[17] says the relation of the thymus to tetany may possibly explain the occurrence of tetany during pregnancy; while the parathyroids of the mother may be sufficient to prevent tetany from her largely atrophied thymus, they may not be sufficient to prevent tetany from the excess of thymus substance furnished by the fœtus to the blood of the mother.

Thymicolymphaticus, as intimated above, is marked by more or less general involvement of the lymphatic system and also with hypoplasia of the vascular system and the adrenals. Virchow[14] had already described the hypoplasia of the vascular system in 1872 as the "chlorotic constitution." Hyperplasia of the lymphatic system, on the other hand, may be due to infection and improper hygiene. As Kolisko[15] has remarked the entire lymphatic system can become hyperplastic in consequence of rachitis. Richard Bright first sketched out status lymphaticus in 1838. Oldmacher[18] states that status lymphaticus is divided into the rachitic and non-rachitic types and notes especially the epiphyseal changes in the bones in the first named division. Many of the symptoms of socalled lymphatism, as laid down in the literature, seem to merge into each other and their apparent divergences may in many cases be due to chronological or accidental changes in the same disease. This we might reasonably expect in so changable an organ, as the thymus, both in health and disease. Galatti directs attention to the peculiar tendency

to œdema in status lymphaticus. There may be, he says, œdema of the brain, as noted in the thymectomized puppies already mentioned, as well as eczema and pasty complexion. The external œdema in our case was of course the most prominent symptom. Oldmacher in this connection calls attention to oedema of the lungs, which he has observed in lymphatic epileptics, dying abruptly in a single seizure or sinking into status epilepticus; and claims that slight factors like moderate autointoxication may activate this tendency in lymphatism. He adds that, should cerebral oedema cause pressure on the floor of the fourth ventricle, sudden death would supervene. He is prone to attribute lymphatism, generally speaking, to some slow acting systemic poison. Mayo lays down the proposition that the thyroid is an organ of defense and that more or less aid in this function is received from the normal thymus. And it would appear to be firmly established that in early life, at all events, a normally acting thymus is essential to proper development. It will be observed that Professor Mayo only removed part of the overgrown thymus, just as only part of the enlarged thyroid is removed by operation. Why ablation of part of an improperly functioning gland should obviate its overaction is difficult to explain, unless it may be due to removal of a large part of its secretory elements, and whether this operation does correct temporarily or permanently the vascular hypoplasia, the changes in the chromaffin system and so forth found in lymphatism has so far as I know, not yet been ascertained.

We should notice, before closing, that Gowers urged prophylaxis against rickets, as a preventive measure against epilepsy, and Oldmacher takes similar ground regarding tetany, spasm of the glottis and eclampsia; conditions accompanying, if not always due to lymphatism; while Mendel attributes rickets to disturbance of the internal secretion of the thymus gland. Hence while this study of ours has not been as conclusive as we could wish, it tends to emphasize the fundamental importance of laying the foundation for normal, mental and bodily develop-

ment by insisting on the inalienable right of every infant to be nourished at the breast of a healthy woman.

What other practical conclusions may we draw from the foregoing? The x-ray has removed some at least of the uncertainties of the diagnosis and has seemingly favorably influenced the treatment. The fear that operation will be almost inevitably fatal has been largely removed by the few successful cases reported. These were all in infants so far as I can learn. Whether adults with enlarged thymus should be submitted to the risks of operation has not apparently been determined. However, of the alleged cases of thymic death the large proportion are adults, as said above.

There should be a more strenuous effort made to ascertain whether something definite can not be done to benefit these cases as a whole by hygiene and diet rather than by medication.

It is quite likely that anomalies in the structure and size of the thymus are due rather to a constitutional condition than to primary disease of the organ itself. And these conditions may be brought about by a numer of causative factors. Ewing[22] emphasizes the fact that there are the stages of hyperplasia and hypoplasia of the thymus and the lymphatic system. These stages if properly carried out seem to be normal to growth and development of the human body. Interference with or undue activation of these processes appear to cause or at least to accompany the condition which is known as status lymphaticus, and this is characterized, generally speaking, by some permanent bodily defects like thin arterial walls; small heart, and an excess of lymphoid tissue and may or may not be characterized by the typus feminis, in the confirmation of the body. Our patient did not evince these outward physical characteristics but he had the tendency to oedema and to aneurysm so well marked in many of these cases.

It is fair to suppose that in time the greatly enlarged thymus in this case would have atrophied and had the aneurysm not occurred as a complication, he might have enjoyed a number of

years of useful life. The aneurysm itself was quite probably caused by over exertion, perhaps by the strenuous run already mentioned in a person with congenitally weak and attenuated arterial walls.

That the x-ray was so efficient at first, and so ineffective afterwards was, it may be assumed, because at the first x-ray treatment the aneurysm had not developed but that at the second it had become a controlling factor in the morbid condition.

My thanks are due to Drs. Baker and Grady for material help in preparing this paper.

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TREATMENT OF INFLUENZA AND ITS PULMONARY COMPLICATIONS.[1]

By J. M. ANDERS, M.D., LL.D.

Prophylaxis.—From the appearance of the earliest symptoms strict isolation should be adopted. This is especially important when an extensive epidemic of malignant type is prevailing in the vicinity, or elsewhere. E. W. White[1] has reported an epidemic of influenza that was successfully aborted by strict isolation of the patients. Whilst it is a difficult task to carry out an absolute quarantine, except in children and aged persons, in which cases it should always be done, yet recollecting the undue susceptibility of persons in the age-group of from 20 to 35 years, and also the relatively high death rate at this period of life, isolation becomes a matter of the utmost importance. Among other prophylactic measures of great value is thorough disinfection of the catarrhal discharges, especially the bronchial, and also those from the naso-pharynx and mouth cavity.

The wearing of suitable masks by physicians, nurses and attendants is counseled by many clinicians. Weaver's[2] experiments have demonstrated that gauze will remove bacteria from the air when carried in a moist spray. "The efficiency of the gauze as a filter is in direct ratio to the fineness of the mesh and the number of layers." L. Hill,[3] however, asserts that the wearing of a mask, by raising the temperature and humidity of the air breathed, is against the natural defensive mechanism of the respiratory membrane.

Sahli[4] of Berne regards masks as unfeasible. One of his objections is that the conjunctive may be a portal of entry for the influenza bacilli and another is that the air forced in and out make strong currents which sweep the bacteria along. He continues; the physician can protect himself against the coughing

patient by having the attendant cover the patient's face with a towel or the drawn-up flap of the shirt while he is examining the chest. On examining the throat protecting goggles are worn, as for diphtheria patients. In this connection, it is worthy of note that the balance of testimony speaks in favor of immunity in the vast majority of the cases by an attack of influenza. It is probable at least that those who escape infection during a pandemic have become immunized by an inhalation vaccination. The prevention of droplet infection is of prime importance, hence the patient should be also instructed to cough into his handkerchief when not too ill. The washing of the hands of physicians and the public is an important prophylactic measure.

It is not possible to over-emphasize the importance of absolute confinement in bed until convalescence is well established. The development of fatal pneumonia as a complication is quite commonly traceable to a premature getting up or exposure to the out-of-door air. Drugs (*e.g.*, quinine with or without whiskey and salicin) have been vaunted for their preventive effect, but in my view their value is questionable. Influenza has quite properly been placed on the list of notifiable diseases in certain leading American cities, *e.g.*, New York, Philadelphia and Chicago.

Recio[5] lauds polyvalent mixed anti-influenza bacterin as a prophylactic. In a group of 300 persons thus vaccinated only five developed influenza during a severe epidemic, while none of 100 children so treated contracted the disease. Hinaker[6] and Irvine have found that a noteworthy degree of protection against influenza and its complications was obtained by means of a mixed vaccine freshly prepared from predominating etiologic bacteria. With the germs derived from the sputa and secretions in some grave cases, Casabo[7] prepared both a vaccine and a bacterin of which 10,000 doses (four ampules each) were distributed, with most favorable reports of its prophylactic action.

Beihn[8] states that a new vaccine for prophylactic vaccination against influenzal pneumonia that holds a great promise from a

scientific and practical standpoint, is a type of lipo-vaccine that was originated abroad. Chitmire and Peterson[9] have obtained favorable results with this type in which the organism is suspended in an oil-lanolin. Owing to the slow absorption of the lipo-vaccines, the entire immunitizing dose has been given at a single injection. There is no reaction and the immunity against types I, II and III is said to be just as good and probably better than the three doses we have heretofore been giving. On the other hand, Park states that no data are available as to the effect of vaccine as a preventive or therapeutic measure in true epidemic influenza.

Treatment of the Attack.—Certain hygienic measures including the diet are of first importance in the management of influenza. Cooling drinks are to be preferred to hot ones, and the fluid intake should be large. In cases of moderate intensity and in the severer forms, the diet during the febrile stage should be composed of nutritious liquids, such as milk, buttermilk, orange juice containing the white of egg, and broths to which strained rice or farina may be added. These should be given at two-hour intervals unless the patient be sleeping. During convalescence soft articles may be allowed for a couple of days and then a return to easily digestible, nutritious solids is to be made in a gradual manner. In mild or rudimentary types, the diet should consist of milk gruels, animal broths, eggs, fresh vegetables, stewed fruits and the like throughout the brief course of the illness, so as to shorten convalescence.

Free ventilation of the sick chamber is advised but strong drafts are to be avoided since they produce a chilling effect and thus tend to induce pulmonary complications. The temperature of the room should not be maintained at too low a level during convalescence and cold bath-rooms have been responsible for cases of complicating pneumonia at this stage. It is a good rule to not permit the patient to leave his bed until the temperature has been normal for a period of at least four days, except in the light forms of the complaint.

We have reached the point at which all cases showing elevation of temperature, however slight, should be kept in bed until it is back again to normal. These mild types need little else in the way of treatment, if we except careful feeding and regulation of the bowel-function. Active purgatives, however, should be avoided. The writer saw the evil effects of purgatives in many instances during the recent pan-epidemic, the horrors of which will long cling to our memories. During and after the febrile stage in these mild grades of influenzal infection we should aim to premote conservation of energy and the hygienic and medicinal treatment must have the same objects in view as in the other prostrating diseases. The patient should be allowed to get up for a part of the day only at first owing to the danger of overfatigue from which recuperation is slow and often unsatisfactory.

In the severer forms the temperature may early touch 104° Fahr. During the pandemic of last autumn the fever generally remitted on the second or third day and either remained normal or more commonly a secondary rise following the remission accompanied by coryza and bronchitis, occurred. The fever and and accompanying symptoms are best controlled by cool sponge baths and the ice cap. Quinine in combination with Dover's powder, alternated with a simple anti-febrile mixture with the object of inducing perspiration may be prescribed with good effect. An efficient diaphoretic, if given at the onset may, as I have observed, abort the attack.

The therapy of the febrile stage usually embraces the use of the depressing coal-tar products, which are merely mentioned here to be condemned. In my view, their harmful effects far outweigh their usefulness; they tend to increase the extreme exhaustion of the convalescent stage not to speak of their marked depressing effects upon the heart's action. On the other hand digitalizing these patients has seemed to me to avert secondary developments more particularly in the lungs. Experience has made me partial to the view that potassium citrate, administered

in 10-gr. doses every third or fourth hour well diluted, is useful as an eliminant.

The severe myalgia is often relieved by resorting to aspirin, but I do not favor its employment for this purpose, having witnessed repeatedly the irritable heart with its rapid fatigue on exertion as a sequel, in cases in which it was used. In my view the myalgic pains can be more successfully and more safely relieved by the use of small doses of morphine.

Persistent neuralgic headache, with tenderness over the sinuses points to sinusitis as the cause, which should receive the attention of the specialist. For severe headache, per se, we may employ caffeine combined with sodium bromide. For the disturbances of the cardio-vascular system, nothing is so valuable as absolute rest.

The bronchitis is relieved to an extent at least by the potassium citrate suggested above, to which may be added ammonium. Chloride and terpin hydrate. If the cough be frequent, and unproductive codeine or dionine exerts a happy effect. A most useful measure is the oft-repeated application of sinapisms to the entire chest. It is highly probable that there is in all cases of considerable influenzal bronchitis, some lung involvement, varying in degree, however, between the two extremes of small islets of infection to massive consolidations. It is particularly at this stage that acetyl-salicylic acid and other depressing agents should not be employed. My own experience has confirmed the value of camphor in oil, strychnine and atropine, hypodermically, the latter seeming to relieve the dyspœa and cyanosis in some cases at least. Epinephrin and pituitary extract and solution, have their warm advocates, but my personal experience of their use has been too limited to base thereon any conclusions. On the whole so little improvement, is noted from cardiac stimulants as to lead to noteworthy discouragement. Small and Blanchard[10] experimented with groups of patients—fifteen in each—and concluded that patients treated by gelsemium improved in a manner far exceeding those given any other medication.

In response to a suggestion made early in October, 1918, that immune serums regardless of their nature might be beneficial, lead Lamb and Brannin[11] to make trials of the so-called foreign protein treatment at Camp Cody. They carried out sensitization tests by a small subcutaneous injection of diptheria antitoxin. "If no indication of anaphylaxis appeared, 10 c.c. were administered by vein. In forty-five minutes a sharp reaction (chill, fever, and sweat) usually began. At the end of from twenty-four to forty-eight hours, if no marked improvement was observed, or if the patient was not moribund, a second dose was given."

These observers also employed other varieties of protein, "such as antimeningococcic, antitetanic, and antipneumococcic serums, and late in the epidemic the use of a bacterial filtrate was instituted."

Their conclusions were the following:

1. Many cases, which appeared at their onset to be of the malignant type, would after its use show an improvement (often unexpected), with subsequent recovery.

2. No improvement resulted unless a reaction occurred. For this reason we were partial to the more concentrated products (diphtheria serum and bacterial filtrate).

3. The same benefit was derived from the antimeningococcic, antitetanic and antidiphtheritic as from the antipneumococcic serum, provided a satisfactory reaction resulted. In other words, there was no apparent specific action of any type of serum, but the result was dependent entirely on its protein content.

4. Early administration was essential to effectiveness.

5. No harm, attributable to their use, was ever observed.

6. From the use of the serums there seemed to be a lessening of the hemorrhagic tendency.

7. While an artificial crisis was desired and anticipated, more often, when benefit did result, it came as a gradual reduction in toxæmia.

Herman[12] in summarizing the subject concludes that "The

intravenous injection of foreign protein serves as a stimulus for the liberation of specific antibodies in animals in which the previously injected antigen was unable to cause such a liberation." Roberts and Cary[13] after critically analyzing their results conclude that protein injections have a very definite value and believe that the procedure will come to be accepted as useful in a wide variety of infectious diseases. The point to be borne in mind in connection with this mode of treatment is that while the injection *per se* is not specific, it calls forth a specific response.

Cowie and Beaven[14] have employed typhoid protein in nine cases of influenzal pneumonia with distinctly encouraging results, although in their limited experience, found that, if used intravenously, it is indicated only in the beginning stage of this disease and that not more than 500 million of dead typhoid bacilli should be given at one injection.

A number of clinicians have reported excellent results from the use of vaccines by giving minute doses of 20 million organisms during the febrile stage. On the other hand to be useful the vaccine must contain the special type of organism with which the patient is infected. Again, I quite agree with Beihn[15] that little dependence is to be placed in the vaccine treatment, although when given early in small non-toxic doses it offers better promise than in larger doses.

The most notable advance in specific therapy has been the injection of the serum of convalescents in the treatment of others suffering from the same type of infection. McLean and Pepper report favorable results from the use of convalescent serum, a physician and a nurse being the first cases. Bacteriologic examinations showed that the patients from whom they obtained the serum had influenzal and type IV pneumonic infection. McGuire and Redden[16] are convinced that the serum from convalescent pneumonia patients has a decided influence in shortening the course of the disease and lowering mortality. To determine the type of infection the services of a laboratory, however, are required in each case, and this is not available to the average general practitioner.

The period of convalescence demands close attention. The marked degree of weakness is shown by the utter exhaustion on the least exertion. Rest, good easily digested food, and tonics are the agencies of choice in attempts to restore normal strength. Incomplete recovery and a tendency to merge into chronic invalidism is often the consequence of a too early return to work. The usual duties and responsibilities of life, therefore, should be resumed in a gradual manner.

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DISCUSSION.

Dr. A. G. Shortle, Albuquerque, New Mexico: My practice is confined to the treatment of tuberculous patients, and my experience during the epidemic of influenza convinced me that the individual having an open tuberculous lesion was, (1), less likely to take the flu than a non-tuberculous, and, (2) that he was less likely to die if he did take it. I and my two assistants must have had at least three or four hundred tuberculous cases under our care during the course of the winter. Seventy-five to eighty per cent. of these were third-stage

cases, and while our town was full of influenza, so many sick that they could not be properly taken care of, we had only comparatively few cases occurring among our patients, and during the entire winter we lost only three patients due to influenza. Two of these three were patients having one lung collapsed (artificial pneumothorax) and a pneumonia occurred in the working lung in both of these. The other patient was a very feeble third-stage case. Indeed, few of our patients were really seriously ill. In searching for an explanation of their comparative immunity, I reached an opinion that patients with an open tuberculous lesion in their lungs, many of whom have secondary organisms along with their tubercle bacilli, have developed a definite resistance or partial immunity to the influenza bacillus, as well as other disease-producing organisms. At any rate, it seemed that they had a higher resistance to the bacteria of the death-producing pneumonia than the non-tuberculous individuals.

Dr. James M. Anders: In closing discussion, I am quite convinced that the recent epidemic did not differ from previous epidemics in kind, but only in degree. Certain unusual complications were also manifested.

Washing of hands is as has been pointed out by others, an important porphylastic measure, since the infection is often carried from hand to mouth.